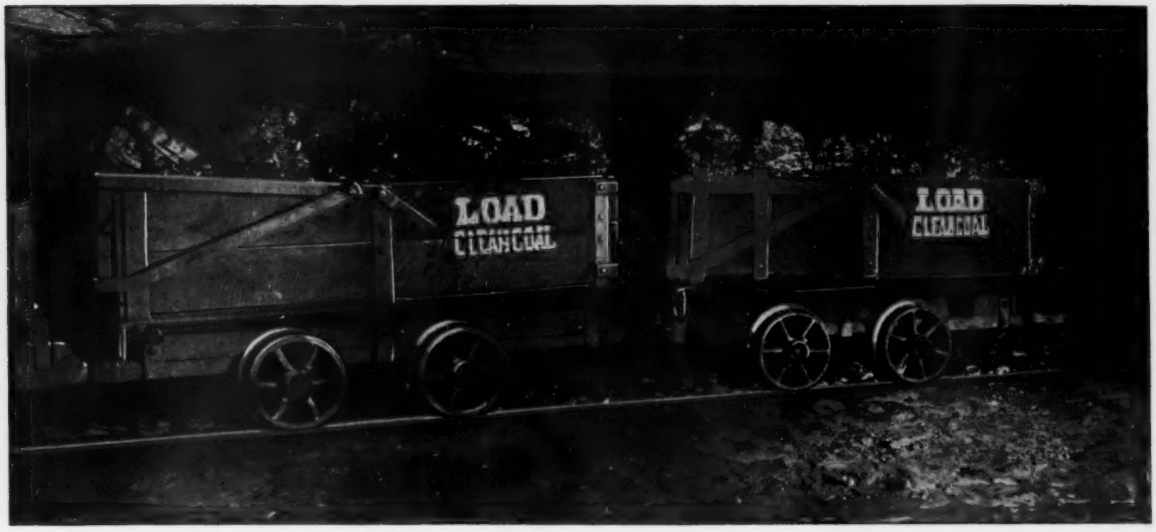
The MINING CONGRESS JOURNAL

Vo. 12 MAY, 1926 No. 5



"The change was made with one object in view~ Economy"

Rutledge and Taylor Coal Company mines a fine grade of coal at their Livingston Mine. But even good coal must be sold at competitive prices. Mining cost must be held to a minimum —economical haulage established.

So—two years ago they began to replace their plain bearing trucks with Hyatt Roller Bearings in self-aligning journal boxes. Evidence of the wisdom of this move is presented in a letter recently sent us by Mr. J. A. Hebenstreit, Superintendent:

"The change was made with one object in view—economy," he wrote, "and after two years' experience, we are convinced the results obtained have come up to our expectations in lowering the power, lubrication and maintenance expense."

Last year the average daily tonnage at Livingston was 4,532 tons. The distance from shaft to tipple is about two miles—and the Hyatt equipped cars averaged two trips per day. They roll so easily that the 13 ton locomotives on the main line were able to haul 25 cars per trip—each loaded with 2,766 tons of clean coal.

Hyatt Roller Bearings under your mine cars will give the same sort of dependable—low cost service. They have been doing this up to 18 years in many mines.

HYATT ROLLER BEARING COMPANY

Newark Huntington Pittsburgh Chicago

HYATT

ROLLER BEARINGS

THE MINING CONGRESS JOURNAL

MAY, 1926

CONTENTS

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EDITORIALS

The Bituminous Coal Industry 327
Conscription of Industry 328
What the Tariff Has Done 328
Safe, Efficient, Profitable Production 329
A Constructive Tax Program 329
Our Diminishing Timber Resources 330
The Revival in Western Mining 330
Investment Capital and Mining 331
Business Insurance 331

FEATURE ARTICLES

Congress and the Coal Industry 332
Annual Meeting Practical Coal Operating Men 333
Program Annual Convention 336
National Exposition Coal Mine Equipment 339
"Patience," the Requisite When Considering Coal—By George H. Cushing 342
Potash and the South—By Frank L. Hess 344
Modern Tendencies in Power Shovels—By F. L. Stone 347
Roof Control in Pillar Work With Mechanical Loading —By Edwin H. Johnson 352
Mining Two Coal Seams Simultaneously Within the Same Boundary—By Fred J. Hogan 354
Mining Under a Bad Roof and Heaving Bottom at Sugarite Mine, New Mexico—By James R. Barber ... 356
The Mechanizing of Our Coal Mines—By Nixon W. Elmer 358
An Experiment in Combined Cutting, Mining and Loading in Coal Mines—By Col. Edward O'Toole 360
Mining Methods Being Used at Ray Mines—By Robert W. Thomas 366
Remodeled Flow-Sheet at Hayden Plant—By Walter I. Garms 369
Pneumatic Placing of Concrete at Ray—By Cyril A. Robotham 371
Water Development for the Hayden Plant—By Nels Johnson 373
Legislative Review 379

DEPARTMENTS

PRACTICAL OPERATING MEN'S DEPARTMENT, COAL 352
PRACTICAL OPERATING MEN'S DEPARTMENT, METALS 366
THE NATION'S VIEWPOINT 388
NEWS OF THE MINING FIELD 392
WITH THE MANUFACTURERS 396

NEWS

The Fire Boss and His Lamp 338
Experimental Blast Furnace 349
Potash Finds in New Mexico and Texas 350
Fellowships Offered by Mining Schools 351
Committee on Wood Utilization Meets 353
Ventilation as Preventive of Mine Explosions 364
Mine Rescue Chart 365
Ignition of Gas by Heated Surfaces 365
Electric-Furnace Refractories 372
Chloridizing, Roasting and Brine Leaching of Ores ... 378
Abnormality in Case Carburized Steels 378
Burton Bunch Appointed Field Secretary, Southern Division 383
Children Taught First Aid 383
New Mine Safety Films Produced 385
Shaking Screens at Coal Mines 385
Zinc Pigments and Salt Sold in 1925 386
Production of Slab Zinc and Rolled Zinc in 1925 386
Magnesium Production Increases 386
Aluminum Salts in 1925 386
Quicksilver in 1925 386
Production of Bauxite in United States in 1925 386
Fluorspar Industry in 1925 387
Production and Imports of Pyrites Increases in 1925 .. 387
Sampling of Quicksilver 387
Increasing the Recovery of Ore 394
New Oil Finding and Drilling Methods 395
Possibility of Finding Oil in Utah and Colorado 395
Importance of Cracking Processes 395
Bibliography on Zinc Retorts 395

PRACTICAL OPERATING MEN'S DEPARTMENT

COAL

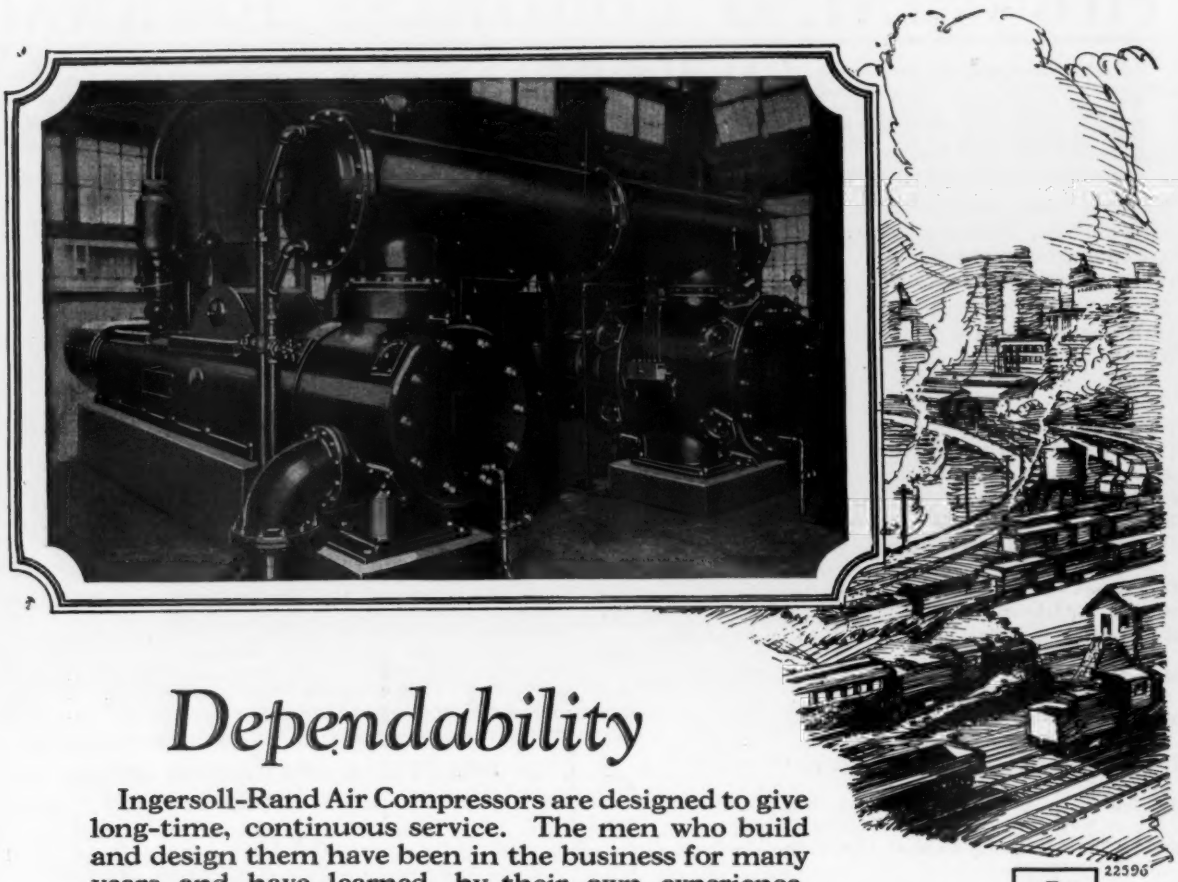
Roof Control in Pillar Work with Mechanical Loading
Mining Two Coal Seams Simultaneously Within the Same Boundary
Mining Under a Bad Roof and Heaving Bottom of Sugarite Mine in New Mexico
Mechanizing Our Coal Mines
An Experiment in Combined Cutting, Mining and Loading in Coal Mines

METALS

Mining Methods Being Used at Ray Mines
Remodeled Flow Sheet at Hayden Plant
Pneumatic Placing of Concrete at Ray
Water Development for the Hayden Plant

Published Every Month by the American Mining Congress, Washington, D. C.

Entered as Second Class Mail Matter January 30, 1915, at the Post Office at Washington, D. C.



Dependability

Ingersoll-Rand Air Compressors are designed to give long-time, continuous service. The men who build and design them have been in the business for many years and have learned, by their own experience, just what is demanded of their machines. They have built them to meet these demands.

All of the material built into I-R Compressors has demonstrated its dependability. The design has stood the test of long years of hard service. The improvement policy has been very conservative, and well it may have been—for the basic design was right. Many years have proved it.

These compressors can be furnished in many different sizes and types of drive. They are adaptable to the needs of any industrial organization and to the individual requirements of any power plant.

Get in touch with one of our representatives. They are trained engineers located in the principal cities of the country, and they are always at your service.

INGERSOLL-RAND COMPANY · 11 Broadway · New York City

Offices in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 260 St. James Street, Montreal, Quebec

831-C

Ingersoll-Rand

New Castle, Indiana, Pumping Station. Equipped with Byers Pipe 37 Years Ago.

37 Years' Service

proves big economy of good wrought iron pipe

HERE is a significant thing about corrosion:

The best metallurgist in the World cannot tell, by chemical analysis or any other scientific means at his disposal, how long a given piece of pipe will resist corrosion. Past performance is practically his only guide. Yet you often hear the claim made that steel pipe, as made today, is so much better than it used to be, that it will last as long as wrought iron pipe.

How does anybody know?

What are the facts?

Bessemer steel, as used for pipe manufacture, is made today essentially as it was made 30 years ago. Likewise, the processes and materials employed in making Byers wrought iron have not changed in sixty years. Hence, it is true about both wrought iron and steel pipe that the only dependable guide to future performance is the service they have given in the past.

Service records show that genuine wrought iron pipe will resist corrosion two or three times longer than steel pipe.

In the photograph is shown an interior view of the New Castle, Indiana, pumping station where Byers Pipe has been in service for 37 years. Recently, a service line was dug out which had been in the ground since 1889; it had suffered very little from corrosion, inside or out. This installation alone, by the practical absence of pipe repairs, has probably saved its owner tens of thousands of dollars. In comparison, the extra cost of Byers Pipe is a mere trifle.

Send for literature

A. M. BYERS COMPANY
Established 1864 Pittsburgh, Pa.
Distributors In All Jobbing Centers

BYERS PIPE

GENUINE WROUGHT IRON

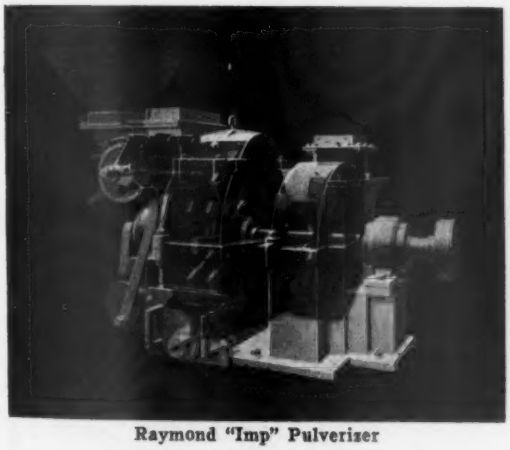
Don't Gamble with Death

ROCK DUST Your Mine!

A Gambler's Chance

NOT a few mines covered with untreated, combustible dust are in operation. It must be true that mine officials and the higher executives are now thoroughly aware of the degree of inflammability of coal dust. With little doubt therefore those who allow combustible dust to accumulate in large quantities without attenuating it with rock dust, or even so much as soaking it with water, are deliberately taking a gambler's chance in hoping for freedom from disaster.

(Coal Age Editorial, March 11, 1926.)



Raymond "Imp" Pulverizer

Raymond Mills are especially suitable for pulverizing shale, gypsum, or limestone to a fineness of 50% or better through 200 mesh screen with extraordinary economy of labor, power, and maintenance. You will find grinding your own rock dust quite inexpensive if you operate the "Raymond" way. Let us give you full information on low cost methods of rock dusting.

The Raymond Bros. Impact Pulverizer Company

A Subsidiary of
INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

342 Madison Avenue, New York
1315 N. Branch St., Chicago
Cotton Exchange Bldg., Los Angeles

COAL CLAY

LIMESTONE CEMENT SAND

O H

Ohio is and will continue to be one of the important mineral states of the Union. Clay is its greatest resource, although today the value of coal produced annually is the greater of the two. The coal is exhaustible, but the valuable clays associated with the coal are practically unlimited. In order of importance in 1922 the principal mineral resources were coal, clay products, cement, gas, and oil. Other resources were limestone for industrial, structural, and agricultural purposes; sandstone for structural and abrasive uses; salts of several sorts; and water for domestic and industrial purposes. Ohio stood first in value of clay products; second in value of sand and gravel and stone; third in value of bromine, calcium chloride salt, and abrasives; fourth in value of bituminous coal, common salt, gypsum, and natural gas.

Of the 88 counties in Ohio 29 produce coal. The coal fields cover an area of about 12,500 square miles, and the production in 1923 was 40,904,275 tons. These mines furnished employment for 55,935 men and paid in salaries $70,994,928.

The first appreciation of the oil and gas resources of the state was arrived at from drilling of salt wells. Every county of the state has been drilled for oil to a greater or less extent, and it is, therefore, improbable that any large pools will be discovered; peak production was reached in 1896 when 24,000,000 barrels were produced. Since that time production has declined and in 1921 was only 7,330,000 barrels.

Natural gas was discovered in Ohio at an early date, but it was not until 1912 that gas was obtained in important

Products of the

GAS OIL

I O

GRAVEL GYPSUM SALT

quantity and then it was struck in the "Clinton" sand. The "Clinton" sand, though comprising an area of only about 800 square miles, has in part supplied cities, towns, and villages of more than two-thirds of the state with gas from 10 to 30 years, and it is not yet exhausted. It has been one of the greatest sources of natural gas of any territory or formation in the world, but is inadequate to supply the demand which it has created.

In 1920 Ohio was behind only Michigan and New York in the production of salt; stood fourth in rank in the production of gypsum; the value of its industrial limestone exceeded $9,000,000; from its sandstones Ohio produces grindstones, pulp stones, oil stones, and scythe stones, and in 1921 produced 93 percent of the grindstones of the United States. Its pulp stones are shipped in large quantities to Canada and even find so distant a market as Japan.

Ohio clays and shales make the state the center of ceramic industries of the United States. Ohio ranks first among the states in value of output and the ceramic industry is second among the industries of the state.

Peat forms one of the large but little appreciated resources of Ohio. While it is little used there today its uses elsewhere are prophetic for the future. Peat is not only consumed in the time-honored blocks in Germany and Ireland for fuel, but is burned in great quantities in powdered form and in briquettes. It is the basis for the manufacture of industrial coke, illuminating and fuel gas, and in Canada for the producer gas engine. Other uses are for tar, ammonium sulphate, ethyl alcohol, dye stuffs, tannic acid, paper, woven fabrics, building board, mattresses, and sanitary appliances.

"Buckeye" State

EXHIBITORS
Section

The NATIONAL EXPOSITION COAL MINE EQUIPMENT, CINCINNATI, OHIO, MAY 24-28

The ANNUAL CONVENTION

PRACTICAL COAL OPERATING OFFICIALS

and the

NATIONAL EXPOSITION

COAL MINE EQUIPMENT

Safe . . .
Efficient .
Profitable .
Production

Cincinnati

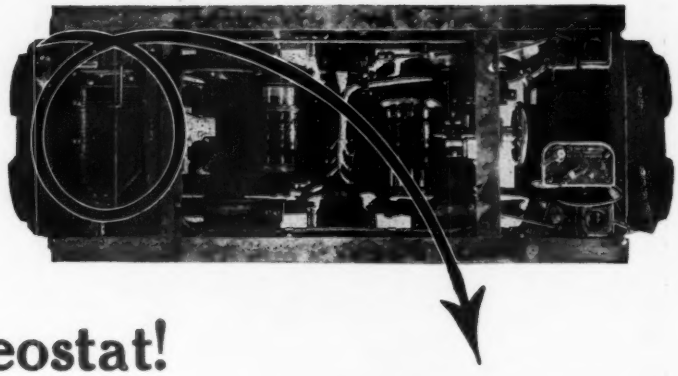
May 24-28

1926

Goodman Locomotives

Save Labor
Save Dollars

Why?



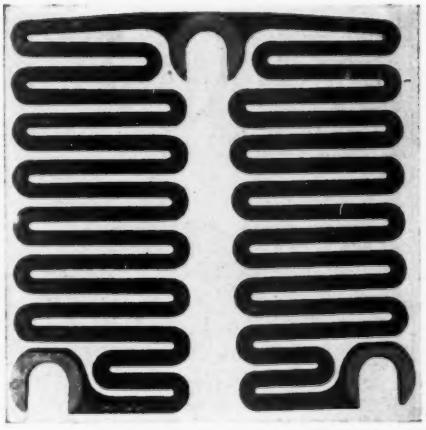
3-Look at the Rheostat!

A Rheostat Is Known by its Grids—

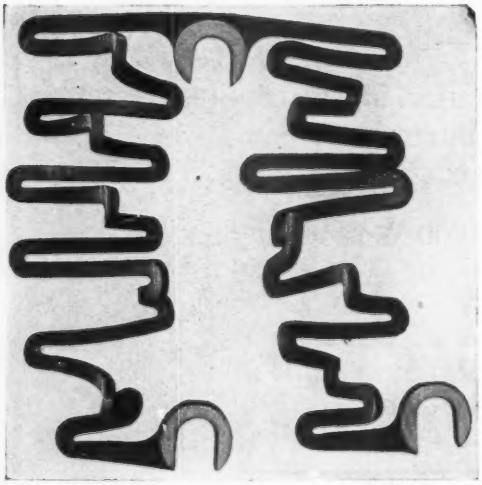
Goodman Rheostats are known by their Grids of Alloy Steel.

These Alloy Steel Grids---

1. Can be dropped, hammered or bent—and will not break.



A Goodman Rheostat Grid of Alloy Steel

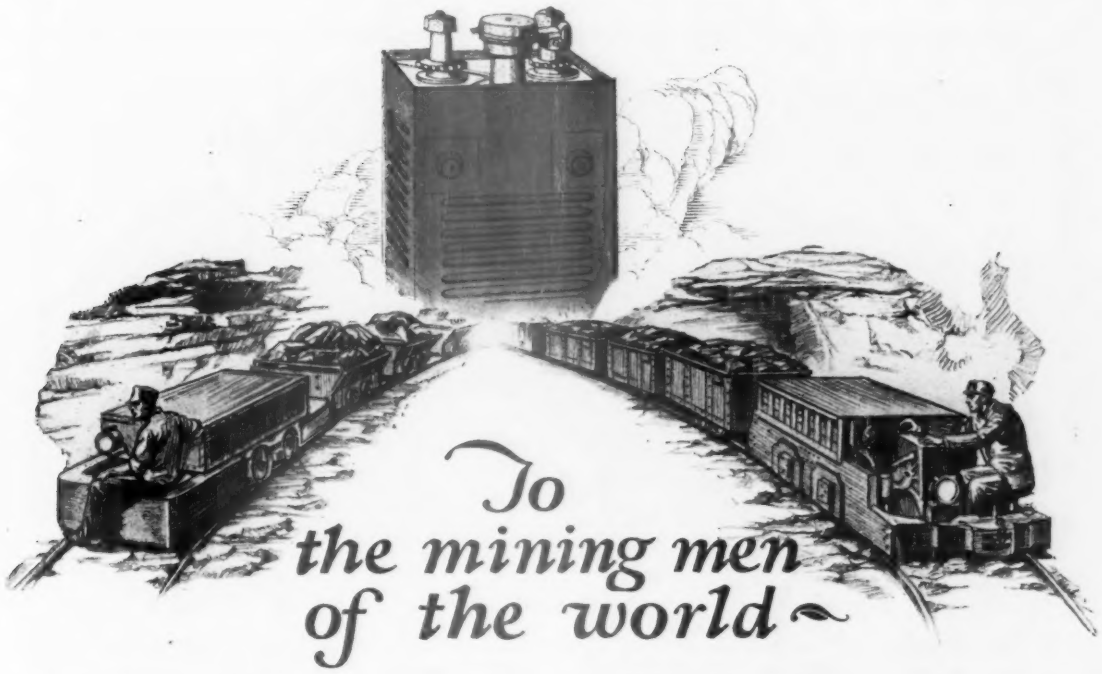


An Alloy Steel Grid Bent All out of Shape

2. Will not sag when red hot, and can be bent without breaking.
3. When red hot (1200° F.) have a tensile strength approximately twice that of a cold cast iron grid, and about the same as that of a cold steel grid.
4. Have electrical resistance and capacity much higher than plain steel, and about the same as cast iron.
5. Maintain a nearly constant resistance throughout the wide range of temperatures to which resistances are subjected.
6. Will not rust.
7. Have open eyes, for easy removal and replacement.

(10)

GOODMAN MANUFACTURING COMPANY
PITTSBURGH CHARLESTON, W.VA. ST. LOUIS DENVER
4746 to 4854 South Halsted Street
CHICAGO, ILL.
CINCINNATI HUNTINGTON, W.VA. BIRMINGHAM



To the mining men of the world

Storage battery haulage stands approved. Its economy has been demonstrated. But the *full* economy of the system rests in the battery. Here are the facts:

The Edison Storage Battery is unequalled for *strength*. It is made of *steel*.

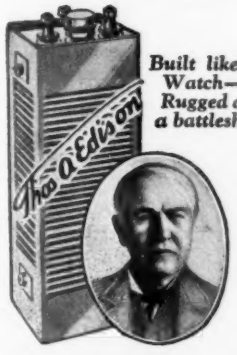
It has not an equal in *length of life*. Different from all others in principle, the Edison Battery with electro-chemical reaction completely reversible lasts from three to four times longer than any other on the market.

And the Edison Battery has no equal in *low cost of maintenance*. Very little attention is required, no equalizing charge is needed to maintain the battery at full efficiency; and overcharge, short circuit or complete discharge can not cause permanent injury to the cells. As a result of these factors, mine locomotives powered by Edison Batteries invariably show the lowest costs per ton-mile.

Over 65%* of all motive power batteries in use today are Edisons. The percentage is growing. Are your locomotives Edison equipped?

*This figure is based upon the latest reliable inventory of industrial motive power batteries.

EDISON STORAGE BATTERY COMPANY, ORANGE, N. J.



Built like a Watch— Rugged as a battleship

Edison

STEEL-ALKALINE*

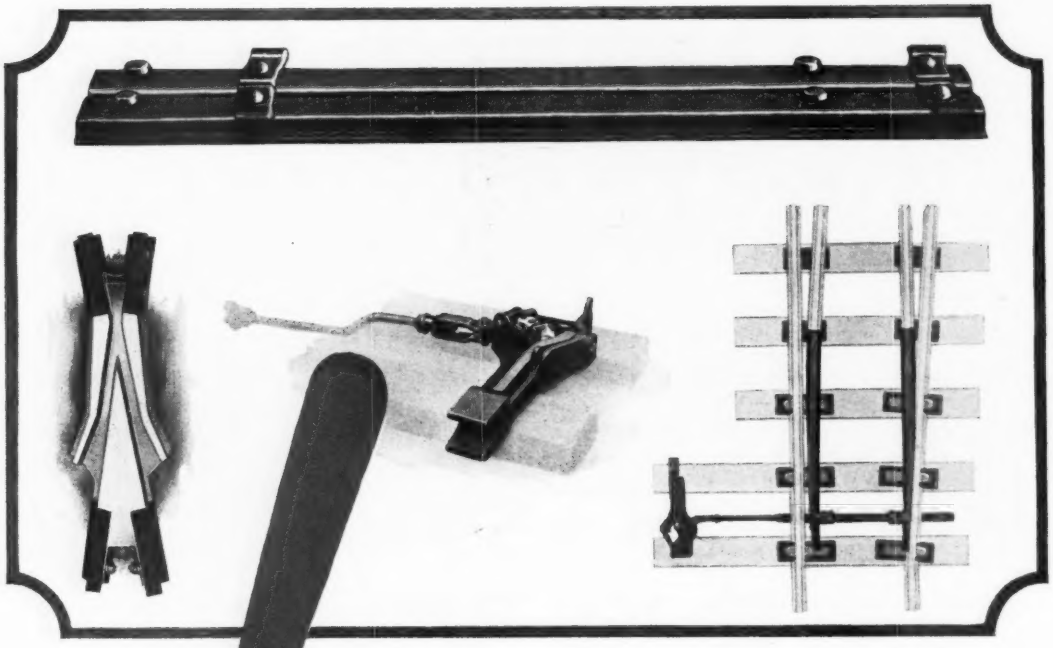
STORAGE BATTERIES

*Edison Batteries are the only batteries of commercial importance, regardless of trade name, which use iron or steel in their construction or elements. All other batteries are constructed of lead and sulphuric acid with hard rubber container.

ATLANTA BOSTON BUFFALO CHICAGO CLEVELAND DETROIT HUNTINGTON LOS ANGELES
NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON

Export: 26 West Broadway, New York *Canadian Distributors: International Equipment Co., Montreal, Quebec*

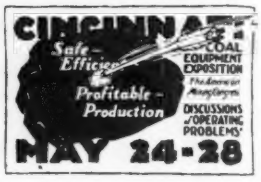
HAUL MORE FOR LESS MONEY



Cut Costs!

Bethlehem heavy duty trackwork cuts mine transportation costs.

Booths 119-120



Bethlehem Industrial and Mine Track Specialties

Bethlehem Mine Ties, Frogs, Switches, Switch Stands, Rails, Splice Bars, Tool Steels, Alloy Steels, Structural Steels, Steel Sheets, Bolts, Nuts, Spikes, Coupling Pins and Links, Mine Cars, Mine Car Sprags and Grimm Rail Clamps.

Catalog sent on request

BETHLEHEM STEEL COMPANY, *General Offices:* BETHLEHEM, PA.

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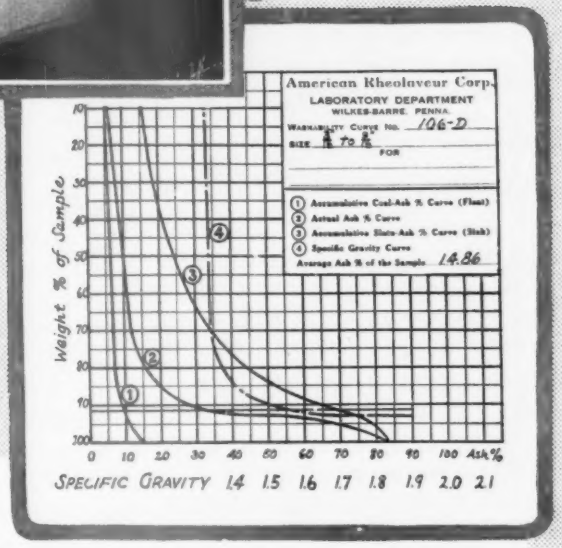
BETHLEHEM

EVERY RHEOLAVEUR INSTALLATION

IS DESIGNED SCIENTIFICALLY

and Gives Maximum Recovery at Minimum Cost.



The Rhéolaveur
CURRENT WASHER

"One reason for the immediate success of the Rheolaveur installations is due directly to the fact that every Rheolaveur washing plant is designed as near as possible to fit the conditions peculiar to the coal which is to be washed. A washability curve is of untold value in the washing and preparation of coal. From it, you can tell whether a washing plant is accomplishing results approaching the theoretical maximum of separation. If you are interested in improving the marketability of your coal, increasing your recovery and reducing your preparation costs, write us for information.

Our Laboratory and Engineering Department are prepared to make complete analysis of any coal and a thorough study of any plant.

Based on analysis, washability curves and study of plants we are prepared to make definite recommendations for any coal cleaning problem.

We are occupying Booth No. 92 at the Mining Congress Exhibit in Cincinnati and welcome the opportunity of discussing the Rheolaveur with those interested.

American Rheolaveur Corporation

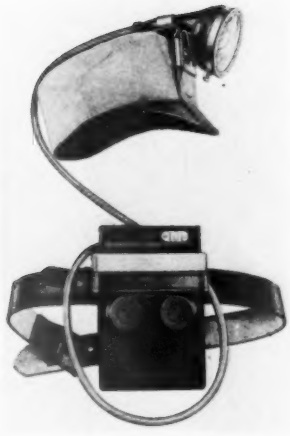
120 Broadway, New York, N. Y. 911 Coal Exchange Bldg., Wilkes-Barre, Pa.

The SUPER WHEAT

ELECTRIC SAFETY MINE LAMP

has been approved by the U. S. BUREAU OF MINES

[Approval Number 20
April 27, 1926]



This great increase in light is without much increase in weight. The average weight is 5 lbs. 3½ oz. complete. It is well balanced and wears comfortably.

THIS approval makes possible the safety provided by an electric cap lamp with the illumination of the best carbide lamp. It is a great advent in the history of electric cap lamps. Where an ordinary lamp is considered good, showing a bean candle power of 6 the Super Wheat gives 15.

The bulb has a tungsten filament, is gas filled and has all the advantages of an automobile head light bulb. The emergency bulb is equal to any other approved bulb giving a beam candlepower of over 6. A switch on the headpiece makes it possible to use either bulb.

The battery, designed to supply 12 hours light gives actually 13 to 15 hours service. Using the emergency bulb it will supply light for 24 hours.

All Wheat Racks and Charging Equipment easily adapted to charge the Super-Wheat Electric Mine Lamp and all repairs readily handled by your own lampman.

BOOTH 18

KOEHLER MANUFACTURING CO.

MARLBORO, MASS.

Complete Lamphouse Equipment

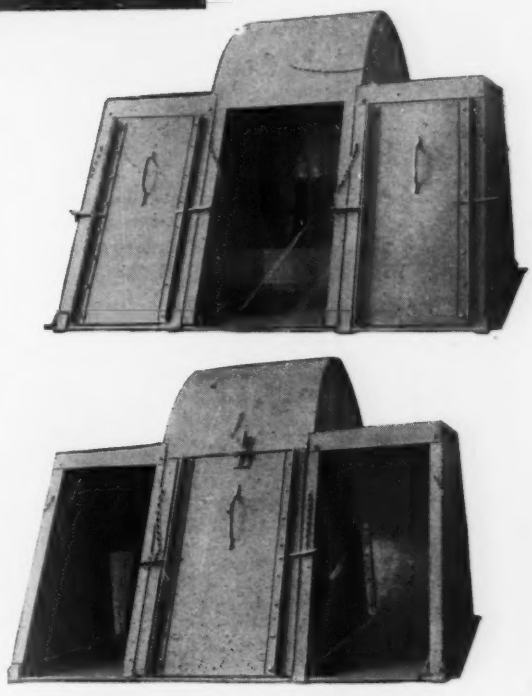
COMBINES SAFETY OF ELECTRIC WITH ILLUMINATION OF CARBIDE LAMPS

A 6-foot Lodwick Reversible Fan installed by the Mullen Coal Co., McAllester, Oklahoma, and used as an exhaust fan.

From BLOWING to EXHAUST Fan in less than a minute

Shifting the doors of the Lodwick Reversible Fan reverses the air current; and this simple operation can be completed in less than a minute. These fans are simple in plan and rugged in construction. The propeller and the housing are designed to eliminate eddy currents and back lash. The bearings are self-aligning, easy running. Purchase and installation costs are low.

Our catalogs present data helpful to intelligent selection of mine fans and our engineering experience is at your service. Consult with us before installing any new mine equipment.



Housing of the Lodwick Reversible Fan. Above, arranged for exhaust. Below, arranged as a blower.

Centerville Coal Equipment

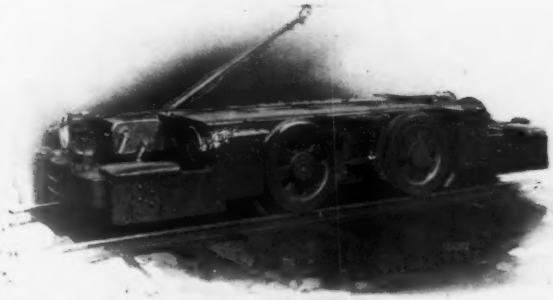
Mine Fans
Dumping Cages
Dirt Dump Equipment
Weigh Pans
Coal Chutes
Mine Cars
Long Wall Conveyors
Shaker Screens

The Centerville Foundry & Mfg. Co.
Centerville, Iowa

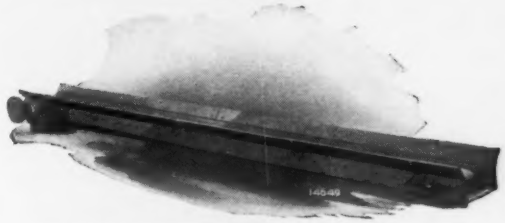
LODWICK REVERSIBLE FANS

ey Exhibit

44-B CONVEYOR-LOADER (Patents Pending)
A Self-Loading Sectional Conveyor for Long-Face Mining. Flexible in both horizontal and vertical directions.



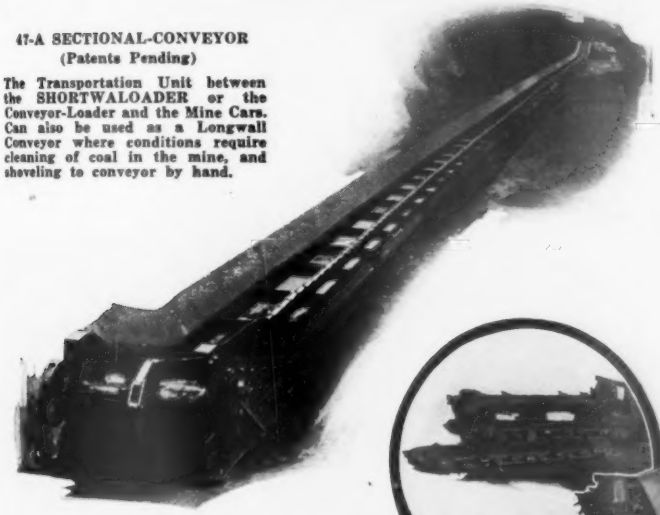
NEW LOW TYPE CABLE REEL LOCOMOTIVE FOR THIN SEAMS

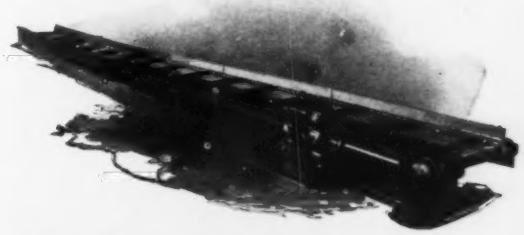


PORTABLE CONVEYORS, BELT (ABOVE) OR CHAIN TYPE (BELOW)
For drawing pillars—working in wide rooms—or where coal is loaded by hand.

47-A SECTIONAL-CONVEYOR
(Patents Pending)

The Transportation Unit between the SHORTWALOADER or the Conveyor-Loader and the Mine Cars. Can also be used as a Longwall Conveyor where conditions require cleaning of coal in the mine, and shoveling to conveyor by hand.





43-A SHORTWALOADER (Patented—Other Patents Pending)
A machine that Cuts, Loads and Conveys—stays in the same working place shift after shift. Below, the SHORTWALOADER is shown with cutter bar in position for undercutting. Insert view shows two upper bars swung into place for loading.

Coal Mine EQUIPMENT

The tipple of the Warden Mine, including the entire conveyor and loading system, is completely Timken-equipped. Allen & Garcia, engineers.

From Face to Railroad on Timken Bearings

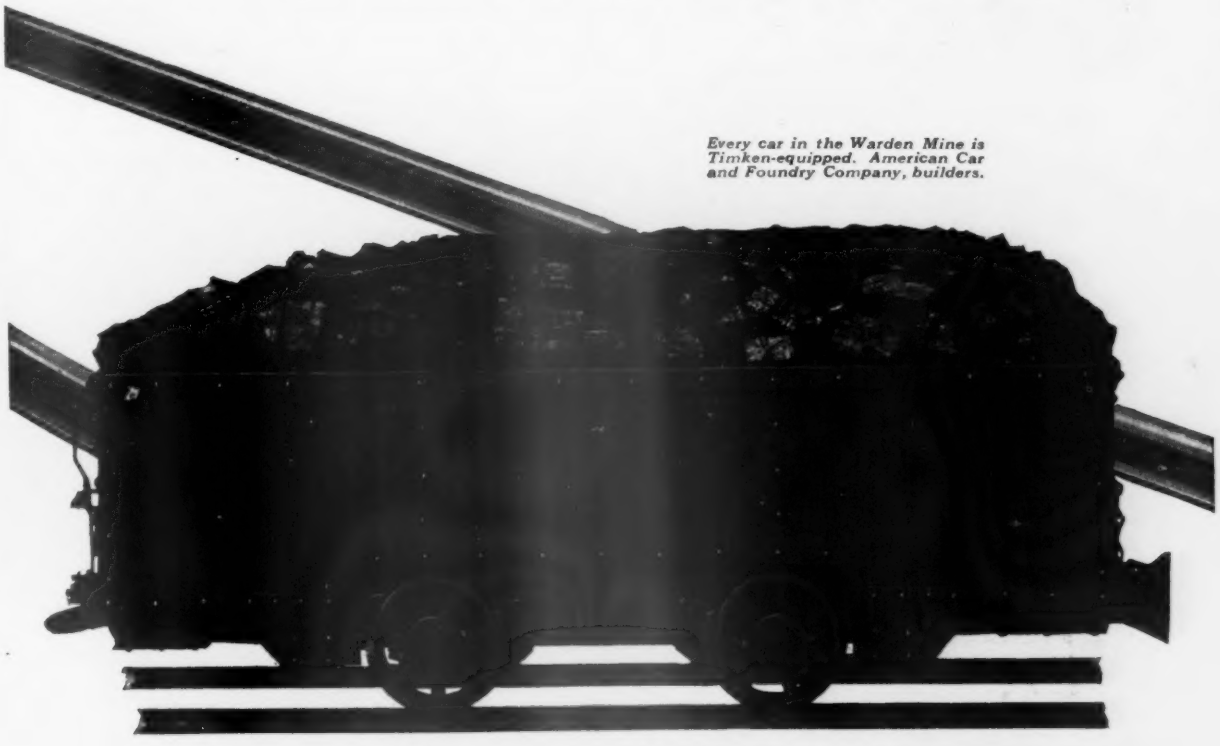
A world-famed operator like the Pittsburgh Coal Company—a high-efficiency property like their Warden Mine—and it is only to be expected that Timken Tapered Roller Bearings will be most widely used throughout the equipment.

All the Warden mine cars, built by American Car and Foundry Company, run on Timken Bearings. All the conveyors, the loading booms, the whole Warden tipple—designed by Allen & Garcia—are Timken-equipped. It is perhaps the most emphatic preference ever expressed for Timken Bearings in all their dominance of the mining field.

Everywhere, in all types of equipment, Timkens save power by eliminating excess friction. Timkens save labor and material by running for months or years on each greasing. Timkens provide the higher load capacity of Timken tapered design and Timken positive roll alignment. Timkens add all the endurance of Timken-made steel. And Timkens permit economical, simple, accessible design, because they carry *thrust!*

All the Timken economies can be yours, since so many leading makes of cars, conveyors and other equipment are designed around Timken Bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO



Every car in the Warden Mine is Timken-equipped. American Car and Foundry Company, builders.

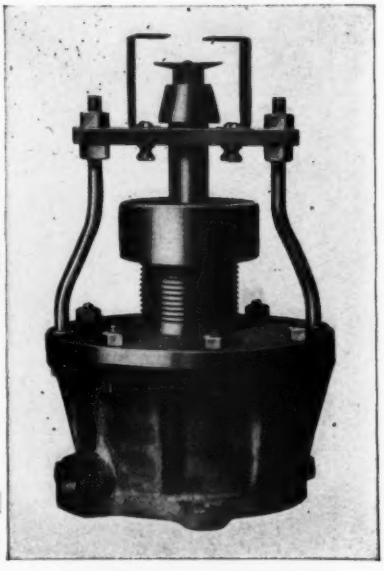
BEARINGS

DRAVO MINE EQUIPMENT

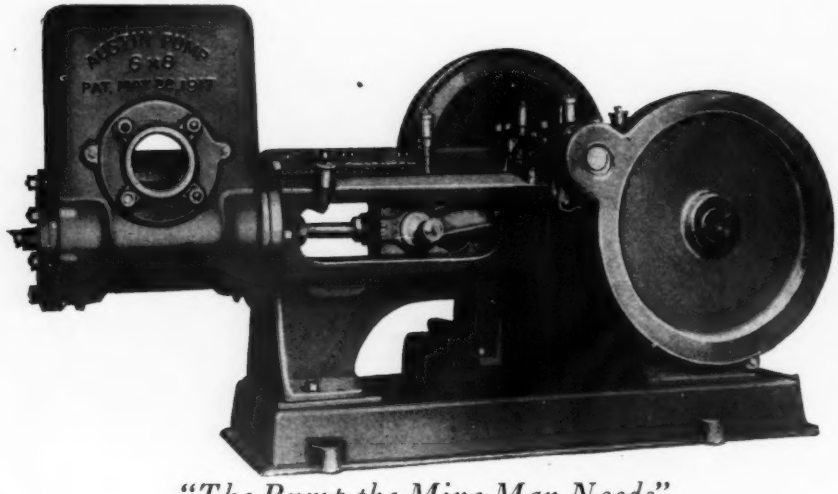
Curtis Automatic Suction Valve

Curtis Automatic Suction Valves eliminate the need for a pump man, permit the use of fewer pumps and smaller pipe lines. Make your gathering pumps Automatic and more efficient.

Insta-Control stops your Centrifugal Pump when it should be stopped.



INSTA-CONTROL



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Centerville Foundry & Machine Co.
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CINCINNATI, OHIO « » MAY 24-28

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Sunlight and Shadows in
Rock Creek Park

The
MINING CONGRESS JOURNAL

PUBLISHED EACH MONTH BY
Subscription Rate: Per Year, $3.00

THE AMERICAN MINING CONGRESS

MUNSEY BLDG., WASHINGTON, D. C.
Single Copies: $0.30

VOLUME 12 | MAY, 1926 | NUMBER 5

THE BITUMINOUS COAL INDUSTRY

IT is hard to understand why an industry which supplies the most necessary product in our industrial life should be continuously on the verge of bankruptcy.

The bituminous coal industry is mechanically in advance of the times and still seeking further economies and efficiencies. The individual operator seems to believe that his only hope is to so improve his operating methods as to be able to undersell his competitors and thus find a market for his full capacity production. Most of his competitors are doing the same thing. His comparative relation to the markets remains the same as if none of these improvements had been made.

This process in some industries might lead to stability, but in coal it but adds to the difficulties. *The difference lies in the fact that all the coal for this and all future generations is now in existence and awaiting production.* If it could all be mined and consumed this year, future years would be without coal. In spite of these conditions the average operator apparently hopes to win in a field of forced competition and pursues with fervor the vain hope that by some process his competitors will be unable to maintain corresponding improvement in mining methods.

Thus we have an industry already grossly overdeveloped still adding to its investment, still increasing the ferocity of its competition, still hoping that bankruptcy will come to enough competitors to make the situation tolerable, entirely blind to the fact that the bankruptcy of a mining company only leaves the mine which it operated a more dangerous competitor when reopened with capital investment decreased by the amount of the first operator's loss.

There are, it is true, a considerable number of those who believe that the present tendency toward consolidation will accomplish a solution. Undoubtedly this will accomplish some good by eliminating some high cost operations, but it will not stabilize the coal industry. Even were it possible to consolidate all of the present production in a few enormous operations the present dormant coal reserves would quickly build up a new competition. Even were it possible to organize into two great operations the union and non-union fields the war would go merrily on, with each field able to meet the whole market requirement handicapped only by transportation costs.

What the industry needs is a sensible organization which will control production to meet the requirements of consumers and be in position to accomplish (1) a better conservation of fuel resources, (2) a better conservation of man power, (3) the continuous operation of the low-cost mines.

Under such unification of the industry the public would have a continuous supply of its fuel requirement at the lowest price consistent with a proper wage to the miner on a basis of continuous employment and a fair profit to the producer.

It is undoubtedly true that the cheapest coal can be produced by the continuous operation of the low-cost mines.

It is apparently true that the price of coal should be based on the cost of operating the highest cost mine, the operation of which is necessary to meet the public requirement.

To illustrate, of 100 mines in a certain district able to produce 100,000 tons of coal, 50 mines can produce at a cost of $2 per ton; 25 mines, at $2.50 per ton; 25, at $3 per ton. If the demand in that district is for 75,000 tons, it will be necessary to operate both the $2 and the $2.50 cost mines, in which case the fair selling price should be based on the costs of the $2.50 per ton mines. Should the demand be for 100,000 tons, then the $3 per ton cost mines must operate to meet the public requirement, and in turn the price must be high enough to enable the $3 per ton cost mine to operate. If these high cost mines do not operate, a demand for 100,000 tons of coal with but 75,000 tons available will create a runaway market with no limit on price.

Any condition which makes possible the operation of the high cost mines at any time means loss to somebody, a general waste in the industry, and in the end higher cost to the consumer.

The public interest requires that the coal industry shall be stabilized—the operators whose mines were opened to meet a proper and probable market will be served by stabilization.

The miners more than all will be served by stabilization, because of continuous employment.

With every properly interested part of the public to be benefited, why can it not be accomplished?

Why can not the industry be so unified as to permit the continuous operation of the low-cost mines?

The first valid answer is that this would mean the destruction of the high-cost mines, which now, during certain unfortunate periods, are able to operate and that these mines in times past have met the public requirement for fuel when other mines have been closed by labor strikes or other unusual conditions and are therefore entitled to protection.

It may be questioned whether the coal mine which can not be operated profitably, except under unfortunate conditions, is entitled to consideration. Such coal mine is in the same situation as the unprofitable gold mine, except that it can not urge, as in the case of gold, that its price is fixed by governmental edict.

Hundreds of gold mines in the West are now idle because war-price levels have put them out of business.

If it cost $25 an ounce to mine gold, no gold mine can operate, because it can sell this ounce of gold for only $20.67 in any market.

The high-cost coal mine must wait until the exhaustion of the lower cost mines, at which time its investment may properly come into its own. Until then its operation means but continual loss and embarrassment to its owner.

We submit that a proper solution of the problems of the bituminous coal industry, next to a stable government, is the most important question before the American people.

We submit that its solution will bring order out of chaos—will save an industry from bankruptcy, will provide steady employment at remunerative wages to a half million workers, many of whom are now on half rations, will make it possible for other industries needing man power to take up the surplus labor in bituminous coal to the great advantage of both and to the Nation.

We submit that the unselfish consideration of these problems by the leaders in the bituminous coal industry can find a solution.

We submit that these leaders owe it to themselves, to the industry, and to the Nation to get together in an honest effort to harmonize the industry, and to make it more effectively serve its function as the most important industry of the country.

CONSCRIPTION OF INDUSTRY

CONTROL over the industrial resources of the Nation in case of war, or when the President shall judge war to be imminent is proposed by a bill now pending before the Senate Committee on Military Affairs. This bill was introduced by Senator Capper, of Kansas, and is understood to be sponsored by the American Legion. It provides for conscription of man power, with no industrial exemptions between the ages of 21 and 30. It gives the President control over the resources of the Nation, including capital and labor, and gives him power to control prices. Under its provisions the President, without waiting for Congress to act, could, through executive orders, proclaim that war was imminent, could declare an emergency to exist, could seize all industries and services, and could fix all prices and rates of interest to remain at their then level for a given period of time.

The bill as proposed leaves the door wide open for possible consequences of an extremely dangerous nature.

Under our Constitution and existing laws, there is no loophole through which a demagogue would be permitted to impose revolutionary and autocratic control over our people, their liberties, or their property. But the Capper bill, unless greatly modified, would leave such a loophole.

There is nothing in the Capper bill which would prevent the President from creating an emergency that would enable him to seize control of all the Nation's resources. Many cases might be conceived of where the exercise of the powers to be granted would amount to confiscation and would lead to conditions infinitely more dangerous to the welfare of the Republic than war. And these conditions could easily be brought about between sessions of Congress.

However worthy the plan may be, neither the Legion nor Congress should lose sight of the possible adverse results that might accrue from an unwarranted or hasty exercise of the powers granted the Executive. Congress will do well to consider such possibilities, even though they may now seem unlikely and remote; and, before enacting such a law for conscription of the Nation's resources, should provide absolute safeguards against any steps in advance of war that might be irrevocable in the event Congress should deem such steps ill-advised or unnecessary.

WHAT THE TARIFF HAS DONE

THE most bitterly contested item in the metals schedule of the Fordney-McCumber Bill was that pertaining to a tariff on manganese. It is interesting to note, after two years, just what that tariff has accomplished.

An editorial in a recent issue of *Daily Metal Trade*, published by the Penton organization, points out the amazing fact that ferro manganese is now being produced more cheaply, under a protected market, than it was produced in a free market. But let us quote them:

"The present low prices of ferromanganese are vindicating fully the contention of every American protectionists from Henry Clay down through William McKinley to the present-day school. That contention always has been that, under protection of a fair tariff, domestic competition would be engendered which would keep down the price. This actually is what has happened in ferromanganese.

"Under the protection of the present tariff law the ferromanganese industry has grown to very respectable proportions in the United States. Three important independent makers in the East are engaged in its manufacture, and considerable is imported from British, Norwegian, and other sources. Had the naive suggestion of the American steelmakers in 1921, then endeavoring to cut production costs under stress of rather adverse business conditions, been accepted in toto by the Washington lawmakers, the independent steelmakers themselves today might again find themselves dependent upon foreign makers of this important constituent of American steel for their vital supplies. The Steel Corporation for years has made its own alloy supplies largely. In other words, but for the present tariff on ferromanganese, America's independent steel trade again would be at the mercy of foreign producers. And we might well have had a situation in ferromanganese akin closely to the situation confronting the American rubber industry out of which the far-sighted British are making considerable capital.

"The price is lower today under the present tariff than it would have been had the infant American industry been wiped out and the steelmakers left to the tender mercies of foreign makers. Now a new American industry is able to stand upon its feet and its future for the first time seems more clearly assured."

This is but one benefit of the tariff on manganese. It has promoted the development of our own resources. Manganese production increased 85 percent in 1925. In addition the steel industry has changed its furnace practice so as to utilize manganiferous iron ores. In 1925 there was 100 percent increase in the production of manganiferous ores.

These things are in line with the arguments advanced by the proponents of the tariff on manganese ores. The result is greater in a short period of two years than even the most ardent advocate of the tariff hoped for. And instead of having a totally underdeveloped industry, we have an industry that will be a real asset to the country.

SAFE, EFFICIENT, PROFITABLE PRODUCTION

AN ambitious slogan is that of "Safe, Efficient, Profitable Production," the password for the annual meeting of practical coal operating men, to again be held at Cincinnati during the week of May 24.

To produce coal profitably is, of course, the main reason for the operation of any mine. The industry always hopes to produce so efficiently that the "profitable" will be automatic; and deep in their hearts every operator wants that word "safe" put ahead of every other possible consideration. But to produce safely, efficiently, *and* profitably is the ultimate goal.

The word "profit" in bituminous coal mining is such a shy beggar as to be practically a stranger. Ways and means to permanently annex it as a business asset is a continuous endeavor of the operators. How they may arrive at it, with safety, and through efficiency, is the major purpose of the Cincinnati meeting.

A substantial percentage of the coal industry is unproductive from one cause or another, and those coal men charged with responsibility of production are taking stock. Thirty-eight of them, representing the important coal-producing districts, recently got together to select, from among the group, a series of problems that seem to be susceptible of solution through cooperative discussion. The result of their effort is a program for the Cincinnati meeting that no man who has an interest in the industry will want to miss.

Interest in these meetings has grown amazingly. As they have demonstrated in results what may be obtained through free and frank discussion, more and more men have attended; more and more men have taken part in the discussions. Policy matters have from the beginning been barred from the discussions. The entire time of the convention is given over to production problems. These conventions are intensely practical affairs. No visionary schemes are promulgated. Those present get down to brass-tack talk, and the result has been that companies who at first sent one man are this year sending a dozen.

Coupled with the convention is the National Exposition of Mine Equipment. These exhibits are a liberal education in themselves to anyone interested in mechanization of the mines. This year's exhibit is unusually attractive. There will be a larger number of operating exhibits; loaders, conveyors, locomotives, and other extremely interesting equipment will be shown in operation. In fact, there will be more than a million dollars worth of equipment on the floor—the latest labor-saving, cost-reducing mine equipment on the market.

If there still remains a coal company not familiar with the tremendous practicality of these conventions and expositions, now is their chance to learn first hand what it is all about. If there is a coal operator, whose duty it is to produce coal economically and profitably, who has not attended these meetings, he should at once join with those who have attended, and send in his application for reduced railroad fare, pack his grip, and get into the vanguard of those now making definite arrangements for "Cincinnati, 1926."

Come to Cincinnati; bring another operator with you. Make this the greatest meeting, with the greatest practical good, ever held for the industry. The coal industry has been, and is, going through the fire of public condemnation because that public believes that coal men can not "get together," and because it believes the industry can not solve its own problems.

Show this public that it is wrong; prove conclusively that the industry acts as one man in its efforts to give to that public coal produced safely and efficiently, with as little profit to the operator and with as low a price to the consumer as is possible *to* produce coal.

CINCINNATI ..... MAY 24-29 ..... 1926.

A CONSTRUCTIVE TAX PROGRAM

THE Joint Commission on Taxation, created by the Revenue Act of 1926 and composed of five members of the Senate Committee on Finance and five members of the House Committee on Ways and Means, will soon begin to function. The task assigned to it is great, but is not impossible, if the Commission will undertake to rewrite completely the income tax law, will confine its substance to general principles and well-defined objectives, and will eliminate from the main body of the statute the numerous special and technical provisions and cross-references which can be segregated and included under a separate division or title where they will not operate to confuse and annoy the great majority of taxpayers, who have no interest in them and to whose returns they have no application.

Once again we repeat that from an administrative standpoint the revenue law has become more technical and complicated with each new act that has been passed. Difficulties of administration are increased year by year as each new Congress adds new and revised administrative provisions to those reenacted from previous laws. The Revenue Act of 1926 is no exception. Geo. E. Holmes, vice chairman of the General Tax Committee of the American Mining Congress, well-known commentator and authority on income taxation, in the April issue of the Bulletin of the National Tax Association, makes the following observation:

"The Revenue Act of 1926 is just a little worse than its predecessors in verbosity and untidiness—a little more meticulous, obscure, and haphazard in substance. It is permeated with special provisions, ifs, ands, buts, provisos, parenthetical expressions, and cross-references. It defies understanding. Its spirit is smothered in words, and it wilts the spirit of anyone who tries to read and understand."

This is not a criticism of the committees of Congress, whose members labored so arduously in the brief time available to frame a measure that would reduce the tax burden. The blame for the complicated and confusing system that now stands on the statute books should rest upon the Treasury Department, if anywhere, because the department has been largely responsible for the continuous departures from simplicity and for the involved interpretative provisions that have been written into the law from time to time for the purpose of giving legislative sanction to administrative regulations, rulings, and decisions of doubtful legality. This has led to the situation described by Mr. Holmes, as follows:

"In the past 13 years we have had seven different laws. Taxes are still being settled under most, if not all, of these acts. Most of them are somewhat similar, but all vary too much from each other to dovetail into a single system. The Government is in fact administering seven different laws. Judicial decisions under one act generally have no value as precedents under succeeding acts. They serve rather to confuse than to aid."

The so-called Couzens Committee had an excellent opportunity to accomplish something constructive by recommending changes in the law that would be in the interest of simplification of the present system. But that committee, after nearly two years of ardent investigation, entirely overlooked this opportunity and concluded its work without proposing a constructive solution for a single problem of administration. Its report attempted to reflect dishonesty upon a great body of taxpayers, and to show biased and incompetent administration on the part of the Commissioner of Internal Revenue and his subordinates in the income tax unit, with the result that it was wholly disregarded by the Senate and House in framing the Revenue Act of 1926.

The new Joint Commission on Taxation will tackle the many problems before it from a different angle. Basic principles will be clearly defined. Causes for the present complexities of administration will be carefully analyzed. The membership of the Commission is practical assurance that it will not be influenced by attacks upon officials of the department or upon exceptional cases of individual taxpayers, and will not be diverted from the task specifically outlined in the law creating it. It therefore should have the full cooperation of both the department and the taxpayers, and should be able to evolve a simplified income tax law that will remove most of the difficulties that now stand in the way of prompt determination and settlement of tax liability.

OUR DIMINISHING TIMBER RESOURCES

THE Nation is at last awake to the necessity for intelligent action, if we are not to be a country devoid of timber resources. The strenuous efforts of a number of organizations and individuals to arouse the public to its almost criminal disregard for our rapidly diminishing timber reserves are at last bearing fruit. Interest in the subject is increasing rapidly, and an intelligent interest is displacing apathy.

President Coolidge some 18 months ago called at Washington a conference to consider ways and means for bringing about a proper conservation, an intelligent utilization, and a clearer understanding of the protective measures needed in considering what remains of our timber supply. That conference was almost futile, in spite of the national aspect lent to it by the President. It voted to create a "Central Committee" to study the subject, but the committee was never organized. The mining industry was represented at the conference by the American Mining Congress, whose representative was appointed as a member of the Central Committee. No action could be obtained, and no really constructive effort was made to get the committee to function, largely because of inability to finance it, the Government having no funds available for the purpose. Finally, after a year and a half, Secretary of Commerce Hoover lent his name and the prestige of the Department of Commerce to a committee to be known as "The National Wood Utilization Committee." Although this committee has the complete indorsement of the Department of Commerce, and Secretary Hoover as its national chairman, its work is financed entirely outside Government funds. The personnel of the committee is now being organized, and plans are under way for the launching of a very big campaign.

In addition to this committee purporting to represent nationally the timber producing and consuming industries, various states are taking up the subject. In Pennsylvania there has already been started a very comprehensive effort to reduce extravagance in the use of timber. In fact, all over the country there is a growing interest in the subject. Scientists are devoting their energies in solving the problem.

An announcement from Cornell University brings out the interesting fact that that university believes it has developed a process that will remove ink from old newspapers, thereby making a hitherto entirely waste product of considerable value in timber conservation. They claim their discovery to be comparatively simple, in that the process reduces newspaper to pulp, and by chemical treatment removes the ink from the mass. Just how important such a discovery is may be realized by considering the quantity of timber that is consumed in the publishing of the Sunday edition of the *Chicago Tribune*. This one newspaper consumes 71 acres of timber in its Sunday editions and 145 acres each week in its other editions.

The mining industry, at an enormous expenditure, uses a tremendous amount of timber annually. It is estimated that they will consume during the current year something like 2,500,000,000 board feet of timber. Anything that will reduce their timber costs and that will at the same time permit of intelligent conservation is of special interest to mine operators.

About six years ago the American Mining Congress, in response to the demands of the metal operators, whose timber problem was beginning to become burdensome, organized a special committee to study the question. Aside from a few companies, that were looking far ahead, little interest could be aroused. In the coal industry practically no interest could be obtained, because there was in the coal fields an overabundant supply of timber. But the committee kept at work, until last year it reported the interesting fact that several large companies had built their own timber-treating plants and were going seriously into the matter of treating their timbers. The coal industry is now taking a decided interest in treating its mine timbers, in conservation of their present supply of timber, and in the reforestation problem. And real progress is being made.

All of these things—the National Wood Utilization Committee, the work of scientists and of our national universities, the growing interest of the mining industry in solving its timber problem—are healthy indications that an earnest interest is being taken in those things that promise to reduce the rate at which the forests are disappearing. The subject is worthy of careful consideration on broad economic grounds, and as an important phase of mining that industry stands ready to do its share in bringing about a solution.

THE REVIVAL IN WESTERN MINING

A GREAT revival of interest in the western metal-mining industries is taking place. This is evidenced by the resumption of mining operations in Colorado and other districts, where for several years somewhat discouraging conditions have prevailed, and also by the fact that well-known and well-informed financial writers, both East and West, are devoting columns to the favorable outlook and the swing toward mining investments.

The general revival of the mining industry in Colorado has been due in great measure to the patience, faith, and courage of the mining men of that state, who refused to give up hope when outside interest had waned and outside capital ceased to flow into the state. There has been a marked increase in the number of men employed

in Colorado metal mines, and many new properties have been reopened.

According to estimates released recently by the Bureau of Mines, Department of Commerce, the production of metals in practically all of the western states during 1925 reflects a healthy condition and an increase in mining activities, which will continue through 1926. At the present time new discoveries, developments, and improvements are contributing to the revival of mining activities of practically every western mining state.

Ten of the leading lead producers of the country, including companies operating in Idaho and Utah, during 1925 earned the highest net profits in their history, from which stockholders received large dividends. These companies have large ore reserves and will continue to earn a high rate of profit even though the prices of metals may decline somewhat from prices prevalent during 1925.

Every banker who has advised investments in European bonds and every Better Business Bureau which has advised the public against mining investments should look into the metal-mining situation. The field of American metal-mining investments is rapidly ripening. American mining investments have paid good returns in the past, and will continue to do so in the future. Opportunities for participating in the development of new mining enterprises with the prospect of large profit are many. And it is the duty of the American investor to place his dollars where they will work for the economic enrichment of this country. The mining industry is not booming, but it is moving forward to a stability that will insure continued growth, and profit to those who move forward with it.

INVESTMENT CAPITAL AND MINING

ONE of the greatest hindrances to the development of new and profitable mining enterprises in the West has been the inability of these prospective enterprises to secure needed capital. Several factors have contributed to this situation, not the least important of which was the publication by the Federal Treasury Department and circulation through the Federal reserve banks of a "warning to investors" in which mining was listed as an uncertain and highly speculative undertaking that should be avoided. This Treasury pamphlet was given to bank depositors, investors, and the press about three years ago, and its injurious effect is still apparent because the unfortunate impression created against mining investments has not been fully overcome.

Another factor has been the known attitude of the authorities of many states and local governments toward the mining industry which has led, in many states, to excessive and discriminatory tax legislation. The American Mining Congress has combatted the tendency to single out the mining industry for added tax burdens which can not, for political reasons, be imposed equally and fairly upon other industries and classes of taxpayers. Recently the American Mining Congress published the facts about the tax burdens of the mining industry and showed, by Government statistics that can not be refuted, how enormously mine taxes exceed those of other industries in proportion to profits, which is the best measure of ability to pay. But the American Mining Congress, in analyzing conditions in the mining industry, did not find any condition existing which should deter any investor from buying mining stocks in going concerns or from investing in any promising and legitimate mining enterprise that is still in the promotion and development stages. On the contrary, the facts revealed showed that the mining industry could be stimulated by fair tax legislation to such an extent that conservative mining investments, which have never been less attractive than investments in other basic industries, would share the benefits that are accruing from the general business and industrial prosperity that prevails throughout the country.

Still another factor that has been a handicap to mine development is the agitation for a Federal blue sky law, which would place in the hands of a bureaucratic power the authority to stifle legitimate promotion of a new enterprise, and to so entwine it with red tape that it would have to be abandoned. This agitation is dying. Federal and state authorities are beginning to realize that every new project in mining or other field of investment means an increase in the tax base from which needed revenue for the maintenance of governments is derived. The attitude prevailing now is to encourage and not to stifle new industrial projects.

Congress was not slow to act upon the data furnished in connection with measures of relief asked for through the repeal of the capital stock tax and the amendment of the discovery clause, which will benefit, particularly, the nonferrous metal-mining industries producing gold, silver, lead, and zinc. The fact that the mining industry has been able to develop new enterprises, to expand old enterprises, to evolve and utilize new methods and processes by which greater recoveries could be had and larger ore reserves created, to carry on and meet the increasing demands of civilization for raw minerals, in spite of the handicaps that have been aired and emphasized, speaks well for the security and soundness of mining investments.

With the change in attitude that is being shown by Federal authorities and by political leaders, both nationally and locally, there has come a pronounced change in the attitude of investors generally, and the mining industry will be able in the future to look to and depend upon sources outside of its own limits for needed capital. New capital, new brains, and new enterprises are always necessary to the growth and prosperity of this industry upon which the whole nation is dependent.

BUSINESS INSURANCE

IF the German-French potash combination should conclude to raise the prices as high as they were in 1920, they could in four years obtain from us more than one hundred million dollars. The prices could be raised so that two hundred million dollars could be taken from us before we could develop potash supplies sufficient for our needs.

The Sheppard bill asks for five hundred and fifty thousand dollars per year for five years, or a total of two million seven hundred and fifty thousand dollars, which is less than 1½ percent of two hundred million dollars. This amount, if spent on such work, could be considered an expenditure for business insurance, an insurance which, if successful in its search, would give us cheap potash for all time, so far as human foresight can see.

What business man would consider 1½ percent of five years business a high price to pay for a perpetual business insurance against loss in his business, even with a fifty-fifty chance that the insurance might fail?

The chances seem better than fifty-fifty that potash deposits adequate to the country's needs can be developed in the great salt bed crossing Texas, New Mexico, Oklahoma, and Kansas, or in the comparatively unknown salt beds of southeastern Utah, or both.

CONGRESS AND THE COAL INDUSTRY

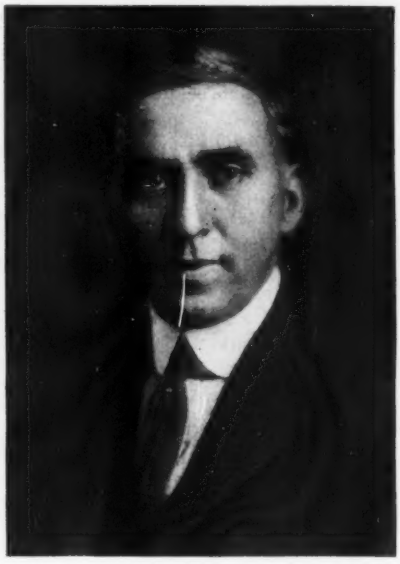
Congressional Hearings Open On Coal Legislation—Members Of Congress Suggest Varying Proposals—Constitutional Conflicts Appear—Fact-Finding Views Differ—Emergency Control Questioned—Consolidation Of Mines Urged

DEFINITE consideration is being given by Congress to proposed legislation on the coal question. The main object appears to be to develop legislation which will be conducive to continued operation of mines in order that the public may be assured of a satisfactory coal supply. The question of coal quality has also been raised and suggestions advanced that regulations be proposed to assure anthracite of proper heating elements, and free from impurities which it is charged have appeared in the coal during recent strikes. The matter of coal prices, particularly for anthracite, does not appear to excite congressional alarm, as it is realized that the public is willing to pay a reasonable price to cover operating and distributing costs if it is assured of a sufficient supply of all kinds of a quality that will give satisfactory heat.

Divergence of views has been reflected in testimony received by the House Committee on Interstate Commerce, which has taken up the question of possible legislation, as to the wisdom of creating a fact-finding agency to regulate the coal industry through the collection of data as to costs and profits, and also as to the feasibility of giving the President authority in an emergency to take over and operate mines. With regard to the first proposition, some Congressmen feel that the Government already has sufficient information as to the operation of the coal industry, obtained through prior investigations by congressional committees, Government departments and coal commissions on which to base legislation. The other view is held that coal legislation and regulation must be based on continuing investigation of the industry by a Government agency. On the question of emergency control of mines, the fear has been expressed that if Congress by law authorizes the President to operate mines in a strike, this legislation would be an open invitation to either side in a controversy to welcome Government operation. The opposite view is that the public interest requires drastic action and that the industry might as well know in advance of the intention of the Government to secure coal for its citizens.

Legislative Need Doubted

Question has also been raised as to the practicability of legislation at this time. Even some advocates of legislation have suggested that between now and the next session detailed investigation be made by the House and Senate committees in cooperation with Government agencies, looking to the drafting of definite proposals for passage at the December session. Some members of the committee have indicated that legislation will be reported out to the House before the present session closes. Whether it will be acted on is a question as Congress is planning to adjourn in June. The committee has approached



Congressman Meyer Jacobstein, of New York

the coal situation with an open mind and has practically given notice that it has discarded the 50 or more proposals for legislation which are before it on introduction of various numbers, and will write its own bill in the light of evidence presented during the hearings.

Some members of the committee have indicated that there is no necessity for coal legislation as economic law will operate to bring about stabilized conditions. They do not see the necessity for general regulation of the industry when so many mines, particularly in Pennsylvania, Illinois, Indiana and Ohio are closed. The thought also is expressed that if the public insists on the right to regulate the coal industry, it should bear some responsibility in preserving its integrity and assuring mine owners a fair profit and workers a reasonable wage. It was pointed out that coal is not the only commodity whose price is regarded as excessive by the public.

There was a general feeling among both the Congressmen appearing before the committee and those sitting on the committee, against price-fixing by the Government.

"The need for relief is recognized, but the problem is to put it into concrete legal form," said Representative Garber, Republican, Oklahoma, a member of the committee. Representative Shallenberger, Democrat, Nebraska, also a member of the committee, indicated his approval of emergency control of mines, saying there had been no trouble when the Government took over the railroads during the war, and it was safe to assume there would be none if the mines were taken over. The hearings were opened by the committee on March 30 and continued for parts of two weeks, being recessed until late in April to hear miners' representatives and others who might desire to present views. The first hearings were completely taken up by members of the House who had introduced proposed coal legislation. Most of these were New York Congressmen, the others being from Massachusetts. The members heard were Representatives Treadway (Rep., Mass.); Jacobstein (Dem., N. Y.); Mead (Dem., N. Y.); Luce (Rep., Mass.); Wainwright (Rep., N. Y.); Black (Dem., N. Y.); Boylan (Dem., N. Y.); and Fish (Rep., N. Y.).

Mine Consolidations

Consolidation of mines and publicity of all facts in the industry to create public opinion to prevent exhorbitant prices and to compel the payment of fair wages to miners was recommended by Mr. Jacobstein, who occupied three sessions of the committee and presented what was regarded as the most complete picture of conditions in the coal industry that had been heard by the committee. To permit these consolidations, however, the congressman said the coal industry should be exempted from the anti-trust law, with a requirement that the industry furnish adequate supplies of fuel at reasonable prices. He also suggested the organization of selling agencies in the industry in order to bring about reduced prices to consumers under supervision of either the Federal Trade Commission or the Interstate Commerce Commission. Re-examination of freight rates on coal, looking to their reduction, and to avoid differentials and conflicts between coal (*Continued on page* 384)

ANNUAL MEETING PRACTICAL COAL OPERATING MEN

For Third Consecutive Year Coal Men Meet At Cincinnati To Discuss Practical Operating Problems—Outstanding Program Arranged By Committee Of 38 Representatives Of Industry—Unusually Interesting Exhibit Of Mine Equipment Will Be Shown

FOR the past three years, during the last week in May, practical coal operating men have gathered at Cincinnati for the special purpose of discussing the problems inherent in the production of coal. These conventions were started three years ago, under the auspices of the American Mining Congress, as an experiment. That organization had held each year an annual convention for the purpose of discussing the economic problems of the mining industry. A growing tendency on the part of the industry to urge, in conjunction with the economic problems, a discussion of some phase of practical operating problems led to the demand for a convention devoted exclusively to operating subjects. The demand grew until in 1924 the organization staged the first of these conventions. Economic problems were barred and the industry was invited to send its men charged with the actual production of coal. They came the first year, and they came back in 1925. This year those companies that have been sending two or three men are sending a dozen. These conventions have proved very helpful to the industry and are now an outstanding event of the year.

At the present time a large percentage of the bituminous coal fields are idle. Those mines that are producing are facing serious problems in production costs. The anthracite industry, just beginning to recover from a six months' strike, is seeking ways and means for cost reduction through mechanical appliances Coal looms large in the industrial field, and the Cincinnati meeting offers an opportunity for operators to get together and discuss ways and means for meeting the situation. No small portion of the difficulties of the industry center about mechanical production. Economic problems in a measure will solve themselves, but production problems can only be

Hugh Shirkie, President of The American Mining Congress

solved through an exchange of ideas and a review of the experience of producers who have been working out their problems with certain types of equipment, under the varying conditions of the field, either with or without success.

Each year has seen listed on the program subjects that have been discussed the previous year. The mechanization of mines is merely in its infancy, although very rapid strides have been made in the past few years. Yet in the experimentation with different types of equipment, each year has brought up a new angle of an old subject. Thus we find in this year's program such old friends as mechanical loading and cutting and blasting. Mechanical loaders have moved forward. The subdivisions of this subject show the trend of that development.

In order that the program might cover the field completely, a program committee was selected, composed of 38 representatives of the industry, including the various coal associations. This committee is highly representative of the industry and has devoted a considerable amount of time over a period of two months in a survey of the field, and in the development of a program that will meet the needs of the industry. George B. Harrington, president of the Chicago, Wilmington and Franklin Coal Co. and a director of the American Mining Congress, is chairman of the committee. Newell G. Alford, of Howard N. Eavenson & Associates, is secretary. Other members of the committee are: Alan C. Dodson, Dodson Coal Co., Bethlehem, Pa ; A. P. Cameron, Westmoreland Coal Co., Irwin, Pa.; R. L. Kingsland, Consolidation Coal Co., Fairmont, W. Va.; A. B. Jessup, Jeddo-Highland Coal Co., Jeddo, Pa.; Lee Long, Clinchfield Coal Corpn., Dante, Va.; G. F. Osler, Pittsburgh Terminal Coal Co., Pittsburgh, Pa.; E. J. Newbaker, Berwind-White Coal Co., Windber, Pa.; C. E. Lesher, Pittsburgh Coal Co., Pittsburgh, Pa.; Ezra Van Horn, Clarkson Coal Mining Co., Cleveland, Ohio; L. E. Young, Union

G. F. Osler

E. J. Newbaker

L. E. Young

Alan C. Dodson

Operating men, members of the Program Committee

Colliery Co., St. Louis, Mo.; Frank G. Morris, Republic Iron and Steel Co., Birmingham, Ala.; H. J. Thomas, Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.; H. F. McCullough, H. C. Frick Coke Co., Scottdale, Pa.; F. G. Wilcox, West End Coal Co., Scranton, Pa.; G. C. McFadden, Peabody Coal Co., Chicago, Ill.; J. D. Rogers, Stonega Coke & Coal Co., Big Stone Gap, Va.; Sterling S. Lanier, Jr., Norton Coal Mining Co., Nortonville, Ky.; R. C. Becker, Keystone Cons. Publishing Co., New York City; Thomas DeVenny, Portsmouth By-Product Coke Co., Edgarton, W. Va.; Harry L. Gandy, National Coal Assn., Washington, D. C.; D. C. Kennedy, Kanawha Coal Opers. Assn., Charleston, W. Va.; W. E. E. Koepler, Pocahontas Opers. Assn., Bluefield, W. Va.; Rice Miller, Illinois Coal Opers. Assn., Chicago, Ill.; C. J. Neekamp, Northeast Kentucky Coal Assn., Ashland, Ky.; E. W. Parker, Anthracite Bureau of Information, Philadelphia, Pa.; S. A. Taylor, Amer. Inst. Mining & Met. Engr., Pittsburgh, Pa.; A. A. Culp, Brown-Marx Bldg., Birmingham, Ala; H. N. Eavenson, Union Trust Bldg., Pittsburgh, Pa.; Frank Haas, Consolidation Coal Co., Fairmont, W. Va.; Lewis O. Lougee, care Geo. Baton and Co., Pittsburgh, Pa.

The result of the work of the committee is a program that has attracted the widest attention and approval of coal operators generally. The first meeting of the committee was held at Pittsburgh, on March 20, and the subjects for discussion were there selected. The committee found such a large number of problems that should come before the convention that they have recommended to the American Mining Congress three major sessions for the 1927 meeting. These recommendations include coal preparation, covering progress in both the wet and dry cleaning process, and long face mining with jacks, etc.

The problems of the coal operator are indeed abundant; never has the industry been in closer quarters as to costs of production; never has there been greater need for concerted action and cooperation. Apparently the industry is determined to further the good work already started by these conventions and expositions, for it is an assured fact that the coming meeting will bring together the greatest aggregation of practical operating men—general managers, superintendents, engineers, electricians, foremen, and all those charged with the mechanical operation of a mine—so far

George B. Harrington, Chairman of the Program Committee

held. This great number of men are coming to Cincinnati to take advantage of, and to give in return, information concerning the results obtained in the industry's progress toward mechanization of mines.

During the past six months several major disasters have taken place in the

Newell G. Alford, Secretary of the Program Committee

industry, and a large number of men have lost their lives because of them. It is the purpose of this convention to discuss ways and means for first preventing mine explosions and, second, development of safety work underground which will lessen the toll of life taken from unpreventable explosions.

In so far as actual mechanization of the mines is concerned, possibly the subject nearest the hearts of the operators is that of mechanical loading and the application of conveyors to mining systems. This phase of the industry's problems will occupy three sessions of the convention, and the subjects scheduled for discussion include "Methods for mining thin flat seams with mechanical equipment"; "Mechanical loaders in pillar work"; "Mechanical loading in room and entries"; "Mechanical Loading on top and bottom rock in entries"; "Loaders that have operated successfully at the face, and their operating costs"; "Typical machine loading failures and reasons therefor"; "Methods of adapting present standard mining systems for best results with mechanical loading"; "Getting mine cars to and from mechanical loaders"; "Inside mine conveyors"; "Room and pillar mining with conveyors"; and "Mining plans for different types of conveyors."

Sessions also will be devoted to Cutting and Blasting; Roof Control and Mining Methods; Underground Transportation Problems; and Stream Pollution Through Mine Drainage.

State Mine Inspector J. J. Rutledge, of Maryland, will preside over the session devoted to mine safety measures, at which the use of rock dusting to prevent coal dust explosions will be discussed by George B. Harrington, who will describe the application of rock dusting which prevented the spread of a recent fire in his company's New Orient mine. Other speakers on mine safety include J. E. Jones, safety engineer of the Old Ben Coal Corporation of West Frankfort, Ill.; T. E. Jenkins, general manager of the West Kentucky Coal Co. of Sturgis; C. E. Enzian of the Berwind-White Coal Mining Co. of Windber, Pa.; George E. Osler of the Pittsburgh Terminal Coal Co. of Pittsburgh; John T. Ryan of the Mine Safety Appliances Co. of Pittsburgh, and C. H. Nesbitt, chief mine inspector of Birmingham, Ala.

The relation of drainage from mines to stream pollution will be presented by Andrew Crichton, consulting engineer of Johnstown, Pa., and Howard N. Eavenson, consulting engineer of Pittsburgh.

Thomas DeVenney

W. L. Affelder

Ezra Van Horn

Howard J. Thomas

Howard N. Eavenson

Amos A. Culp

A. P. Cameron

R. L. Kingsland

Lee Long

C. E. Lesher

F. G. Wilcox

Members of Program Committee

Samuel A. Taylor, president of the American Institute of Mining and Metallurgical Engineers, and a former president of the Mining Congress, will preside over the discussion on this subject, on which the other speakers will be James O. Handy of the Pittsburgh Testing Laboratory and W. L. Stevenson of the Pennsylvania Health Department.

William L. Affelder, of the Hillman Coal and Coke Co., Pittsburgh, will preside over the session which will consider questions concerning the cutting and blasting of coal. Eugene McAuliffe, president of the Union Pacific Coal Co., and James Elwood Jones, president of the Pocahontas Fuel Co., will preside at the mechanical loading sessions; L. E. Young, general manager of the Union Collieries Co. of St. Louis will preside at the session devoted to roof control and mining methods; and R. L. Kingsland, of the Consolidation Coal Co., will preside at the session on underground transportation. Underground conveyors will occupy one session and Howard N. Eavenson, of Pittsburgh, will preside.

The real problem of the coal operator is to secure lower costs through efficiency with safety and with a reasonable profit. The major purpose of these Cincinnati conventions and expositions is to offer an opportunity to get together for an informal discussion of the problems that daily confront the operator, in order that there may be established in the coal industry a medium of friendly contact through which may be obtained safety, which is first and paramount; efficiency which will eliminate waste; and the saving of thousands of dollars to the industry and to the consumer through an interchange of experience that will prevent any operator from attempting to recover his coal through some system that another company, operating (*continued on page* 338)

PROGRAM

ANNUAL CONVENTION

PRACTICAL COAL OPERATING OFFICIALS

NATIONAL EXPOSITION COAL MINE EQUIPMENT

THE AMERICAN MINING CONGRESS—CINCINNATI—MAY 24-28, 1926

Program Committee

GEO. B. HARRINGTON, *Chairman, Chicago, Wilmington & Franklin Coal Co., Chicago, Ill.*
NEWELL G. ALFORD, *Secretary, Union Trust Bldg., Pittsburgh, Pa.*
ALAN C. DODSON, *Dodson Coal Co., Bethlehem, Pa.*
A. P. CAMERON, *Westmoreland Coal Co., Irwin, Pa.*
R. L. KINGSLAND, *Consolidation Coal Co., Fairmont, W. Va.*
A. B. JESSUP, *Jeddo-Highland Coal Co., Jeddo, Pa.*
LEE LONG, *Clinchfield Coal Corpn., Dante, Va.*
G. F. OSLER, *Pittsburgh Terminal Coal Co., Pittsburgh, Pa.*
E. J. NEWBAKER, *Berwind-White Coal Co., Windber, Pa.*
C. E. LESHER, *Pittsburgh Coal Co., Pittsburgh, Pa.*
EZRA VAN HORN, *Clarkson Coal Mining Co., Cleveland, Ohio.*
L. E. YOUNG, *Union Colliery Co., St. Louis, Mo.*
FRANK G. MORRIS, *Republic Iron and Steel Co., Birmingham, Ala.*
H. J. THOMAS, *Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.*
H. F. McCULLOUGH, *H. C. Frick Coke Co., Scottdale, Pa.*
F. G. WILCOX, *West End Coal Co., Scranton, Pa.*
G. C. McFADDEN, *Peabody Coal Co., Chicago, Ill.*
J. D. ROGERS, *Stonega Coke & Coal Co., Big Stone Gap, Va.*
STERLING S. LANIER, JR., *Norton Coal Mining Co., Nortonville, Ky.*
R. C. BECKER, *Keystone Cons. Publishing Co., New York City.*
THOMAS DEVENNY, *Portsmouth By-Product Coke Co., Edgarton, W. Va.*
HARRY L. GANDY, *National Coal Assn., Washington, D. C.*
D. C. KENNEDY, *Kanawha Coal Opers. Assn., Charleston, W. Va.*
W. E. E. KOEPLER, *Pocahontas Opers. Assn., Bluefield, W. Va.*
RICE MILLER, *Illinois Coal Opers. Assn., Chicago, Ill.*
C. J. NEEKAMP, *Northeast Kentucky Coal Assn., Ashland, Ky.*
E. W. PARKER, *Anthracite Bureau of Information, Philadelphia, Pa.*
S. A. TAYLOR, *Amer. Inst. Mining & Met. Engr., Pittsburgh, Pa.*
A. A. CULP, *Brown-Marx Bldg., Birmingham, Ala.*
H. N. EAVENSON, *Union Trust Bldg., Pittsburgh, Pa.*
FRANK HAAS, *Consolidation Coal Co., Fairmont, W. Va.*
LEWIS O. LOUGEE, *c/o Geo. Baton and Co., Pittsburgh, Pa.*

NOTE: This is a meeting of operating men to discuss their problems. All operating officials and engineers are invited to join in the discussions. The chairmen of the meetings, if they desire, may call upon representatives of manufacturing concerns.

There will be no papers. All notes will be delivered without the aid of manuscript. All discussions from the floor are limited to 5 minutes for each person.

TUESDAY, May 25, 1926
10 a. m. to 12 noon
CHAIRMAN—SAMUEL A. TAYLOR

SUBJECT: **MINE DRAINAGE**

1. **"Relation of Drainage from Mines to Stream Pollution."**
   By ANDREW CRICHTON, Cons. Engr., Johnstown, Pa.
   Discussion — HOWARD N. EAVENSON, Pittsburgh, Pa.
2. **"Mine Water Purification."**
   By JAS. O. HANDY, Director, Pittsburgh Testing Laboratory, Pittsburgh, Pa.
   Discussion—
3. **"Restriction of Stream Pollution."**
   By WM. L. STEVENSON, Ch. Engr., State Health Dept., Harrisburg, Pa.
   Discussion———

TUESDAY AFTERNOON
1.30 p. m. to 3.30 p. m.
CHAIRMAN—WILLIAM L. AFFELDER

SUBJECT: **CUTTING AND BLASTING COAL**

1. **"Recent Experience in Shearing and Blasting."**
   By L. E. YOUNG, Genl. Mgr., Union Collieries Co., St. Louis, Mo.
   Discussion—I. N. BAYLESS, Supt., Union Colliery Co., Dowell, Ill.
2. **"Blasting Coal for Mechanical Loading."**
   By B. L. LUBELSKY, Explosives Engr., Pittsburgh Coal Co., Pittsburgh, Pa.
   Discussion—DAVID INGLE, Oakland City, Ind.
3. **"Results from Cushion Blasting."**
   By C. W. NELSON, Explosives Engr., Hillman Coal and Coke Co., Pittsburgh, Pa.
   Discussion—JOHN G. BART, Union Collieries Co., Renton, Pa.
4. **"Cutting in Fire Clay Bottoms."**
   By W. J. FREEMAN, Fayette Realty & Development Co., Terre Haute, Ind.
   Discussion—JOHN L. CLARKSON, Clarkson Coal Mng. Co., Nashville, Ill.

WEDNESDAY, May 26, 1926
10 a. m. to 12 noon
CHAIRMAN—EUGENE McAULIFFE

SUBJECT: **MECHANICAL LOADERS**

1. **"Mechanical Loaders that have Operated Successfully at the Face and Their Operating Costs."**
   By A. W. DICKINSON, Genl. Supt., Union Pacific Coal Co., Rock Springs, Wyo.
   Discussion—WM. J. O'TOOLE, Welch, W. Va.
2. **"Typical Machine Loading Failures and Reasons Therefor."**
   By H. F. McCULLOUGH, Engr., H. C. Frick Coke Co., Scottdale, Pa.
   Discussion—EDWIN H. JOHNSON, Columbus, Ohio.
3. **"Methods of Adapting Present Standard Mining Systems for Best Results with Mechanical Loading."**
   By W. L. McCOY, Mine Inspector, Bertha Consumers Co., Rachel, W. Va.
   Discussion—
4. **"Getting Mine Cars to and from Mechanical Loaders."**
   By CHAS. GOTTSCHALK, Cols. Engr., Evansville, Ind.
   Discussion—F. F. JORGENSEN, Cons. Engr., Superior Coal Co., Gillespie, Ill.

WEDNESDAY AFTERNOON

1.30 p. m. to 3.30 p. m.

CHAIRMAN—JAMES ELWOOD JONES

SUBJECT: MECHANICAL LOADERS

1. **"Methods for Mining Thin, Flat Seams with Mechanical Equipment."**
   By J. F. K. BROWN, Chief Engr., Hudson Coal Co., Scranton, Pa.
   Discussion—FRED G. WILCOX, West End Coal Co., Scranton, Pa.
2. **"Mechanical Loaders in Pillar Work."**
   By ROBT. WALLACE, Supt., Pocahontas Fuel Co., Pocahontas, Va.
   Discussion—W. J. GERMAN, E. I. DuPont de Nemours & Co., Huntington, W. Va.
3. **"Mechanical Loading in Rooms and Entries."**
   By I. N. BAYLESS, Supt., Union Colliery Co., Dowell, Ill.
   Discussion—JAS. NEEDHAM, Genl. Supt., St. Paul Coal Co., Chicago, Ill.
4. **"Mechanical Loading of Top and Bottom Rock in Entries."**
   By A. C. HOHNKE, Supt., Russell Coal Mng. Co., Clymer, Pa.
   Discussion—F. M. FRITCHMAN, Genl. Mgr., B. R. & P. Coal Co., Indiana, Pa.

THURSDAY, May 27, 1926

10 a. m. to 12 noon

CHAIRMAN—HOWARD N. EAVENSON

SUBJECT: UNDERGROUND CONVEYORS

1 **"Inside Mine Conveyors."**
   By NIXON W. ELMER, Cons. Engr., Quincy, Mass.
   Discussion—GLENN SOUTHWARD, Coal Service Corp., 2 Rector St., New York City.
2. **"Room and Pillar Mining with Conveyors."**
   By R. A. SUPPES, Genl. Supt., Knickerbocker Smokeless Coal Co., Johnstown, Pa.
   Discussion—S. W. BLAKESLEE, Supt., Penn. Coal & Coke Corp., Ehrenfeld, Pa.
3. **"Mining Plans for Different Types of Conveyors."**
   By HEBER DENMAN, Pres., Paris Purity Coal Co., Clarksville, Ark.
   Discussion—CLARENCE R. CLAGHORN, 715 Continental Bldg., Baltimore, Md.

THURSDAY AFTERNOON

1.30 p. m. to 3.45 p. m.

CHAIRMAN—J. J. RUTLEDGE

SUBJECT: ACCIDENT PREVENTION

1. **"Proven Advantages of Rock Dusting."**
   By GEO. B. HARRINGTON, Pres., C. W. & F. Coal Co., Chicago, Ill.
   Comments—J. E. JONES, Safety Engr., Old Ben Coal Corp., West Frankfort, Ill.; CHAS. ENZIAN, Chief Engr., Berwind-White Coal Mng. Co., Windber, Pa.; T. E. JENKINS, V. P., West Kentucky Coal Co., Sturgis, Ky.; GEORGE F. OSLER, V. P., Pittsburgh, Terminal Coal Co., Pittsburgh.
   Discussion ———
2. **"Sealing Fires in Gaseous Mines."**
   a. "Current Practice," by JOHN T. RYAN, Pittsburgh, Pa.
   b. "Territory Required," by CHAS. H. NESBITT, Chief Inspector of Mines, Birmingham, Ala.
   Discussion ———
3. **"Fire Protection Underground."**
   By WM. Z. PRICE, Asst. Supt., Buckeye Coal Co., Nemacolin, Pa.
   Discussion ———

FRIDAY, May 28, 1926

10 a. m. to 12 noon

CHAIRMAN—L. E. YOUNG

SUBJECT: ROOF CONTROL AND MINING METHODS

1. **"Elements of Roof Control."**
   By H. F. MCCULLOUGH, Engr., H. C. Frick Coke Co., Scottdale, Pa.
   Discussion—R. Y. WILLIAMS, Cons. Engr., Bethlehem, Pa.
2. **"Roof Control on Long Faces."**
   By E. F. WOODSON, Genl. Supt., Crowe Coal Co., Henrietta, Okla.
   Discussion—W. D. BRENNAN, Genl. Mgr., Phelps-Dodge Corp., Dawson, N. Mex.
3. **"Control of Roof in the Eagle Seam."**
   By JOSHUA KEELY, Pres., Cabin Creek Cons. Coal Co., Kayford, W. Va.
   Discussion—A. A. GALLAGHER, Genl. Mgr., Milburn By-Products Coal Co., Milburn, W. Va.
4. **"Recent Developments in Roof Control."**
   By WM. C. STRATTON, Chief Engr., U. S. Coal & Coke Co., Gary, W. Va.
   Discussion—THOS. H. CLAGETT, Bluefield, W. Va.

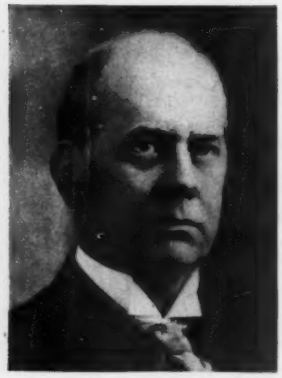
FRIDAY AFTERNOON

1.30 p. m. to 3.30 p. m.

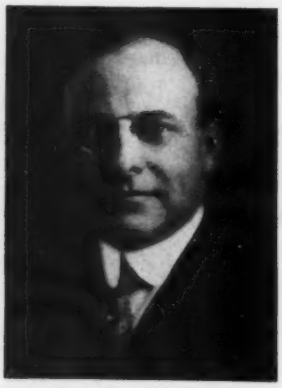
CHAIRMAN—R. L. KINGSLAND

SUBJECT: UNDERGROUND TRANSPORTATION

1. **"Importance of Good Track for Safe, Efficient and Low Cost Haulage."**
   By A. A. CULP, Cons. Engr., Birmingham, Ala.
   Discussion—T. B. DRYER, Asst. Genl. Supt., Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.
2. **"Track Work, Details and Maintenance."**
   By FRED C. HOHN, Cons. Engr., 1429 Wyoming Ave., Scranton, Pa.
   Discussion—THOMAS DEVENNY, Portsmouth By-Product Coke Co., Edgarton, W. Va.
3. **"Selecting a Mine Car Design."**
   By CLARENCE E. WATTS, Mech. Engr., Berwind-White Coal Co., Windber, Pa.
   Discussion—W. D. HOCKENSMITH, Penn, Pa.
4. **"Despatching for Long Haulage."**
   By J. B. HICKS, Elec. Engr., Consolidation Coal Co., Fairmont, W. Va.
   Discussion—THOS. G. FEAR, Genl. Mgr., Inland Collieries Co., Indianola, Pa.



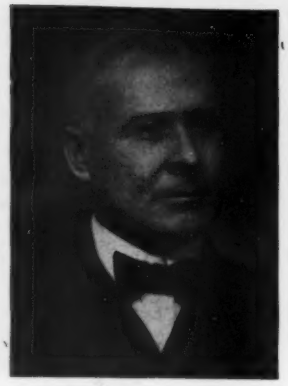
E. W. Parker



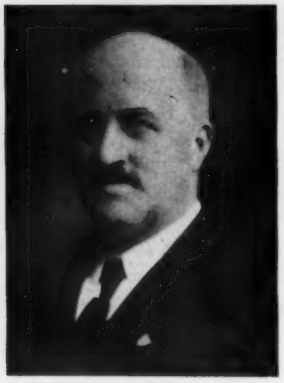
Walter E. E. Koepler

H. L. Gandy

C. J. Neekamp



D. C. Kennedy



S. A. Taylor

Members of Program Committee

ANNUAL CONVENTION

(*Continued from page* 335)

under similar conditions, has found unprofitable.

While the expositions held each year with the convention, have all been instructive, this year's exhibit will perhaps outdistance any yet held. More than 100 manufacturers will show their equipment, many of them through operating exhibits. It has been necessary to increase the tent area in the rear of the building more than 1,200 feet to accommodate mechanical loaders, conveying machinery, and other equipment, all of which will be shown in actual operation. The main floor of the hall will house 87 exhibits. The lobby in front of the auditorium, where the discussions will take place, will also carry a group of exhibits that are of great interest to the operator. In fact, more than a million dollars worth of equipment will be housed in Music Hall during the week of May 24, each manufacturer fully equipped to give the most constructive, concrete service possible to aid mine operators in arriving at some solution of their problems.

One of the major purposes of these conventions has been the establishment of a closer affiliation between the operating man and the manufacturer who makes the equipment which he must use. There is a practically unanimous agreement that cutting costs in coal production rests primarily upon the development of and practical application of new and improved forms of mechanical equipment. The operator is intensely interested in what the manufacturing industry is developing to aid him, and the manufacturer is certainly better informed as to what the industry needs from him, after discussing the industry's needs with the operator. The combination of the convention and the exposition has resulted in real service to the industry.

Entertainment

These meetings are not all serious discussions, not all weighted down with the problems of the industry. Luncheons, dinners, and golf, baseball, dancing, and opportunity for friendly contact are a part of the program.

The American Mining Congress will give its annual dinner and dance on Thursday evening, May 27. This is *not* a banquet. There will be no formality about it. Just a get-together-dinner-and-dance at which there will be one outstanding talk, plenty of music, plenty of fun, and dancing.

The manufacturers will stage again their Smoker, which has become one of the established customs of these meetings, and the program for the Smoker this year is an unusually good one.

The Cincinnati Reds play on the home field during the week, several good golf courses are open to delegates, and Cincinnati has several good theaters and excellent hotels.

Cooperation is an overworked word, but it is the fundamental base of these meetings. They are unaffectedly a cooperative effort to help an industry whose problems are of nation-wide interest.

Come to Cincinnati during the week of May 24 and join in one of the most constructive efforts of the industry.

THE FIRE BOSS AND HIS LAMP

A fire boss should know all about his flame-safety lamp, cautions the Bureau of Mines. He should know just how large a gas cap each 1 percent of gas will give. Some fire bosses can determine the percentage of gas from 1 percent upward. A fire boss should use a low flame when testing for gas, and should not repeatedly put his lamp in gas and air mixtures containing much gas. When he removes accumulations of gas, he should see that only flame-safety lamps are used. He should never carry an open-flame lamp, nor let another man carrying an open-flame lamp travel with him. The fire boss should use a magnetically locked lamp and keep it locked at all times. This is necessary not only for good example, but for the safety of the other men.

SAFETY AWARDS

The U. S. Bureau of Mines has announced winners in the national safety competition for which the "Explosive Engineer" gave a bronze trophy. The winners by groups are:

Anthracite—Upper Lehigh, Pa., mine, operated by the Hazle Brook Coal Co.

Bituminous—No. 6 mine of the United States Coal and Coke Co. at Gary, W. Va.

Metal mines—New York zinc and lead mine of the New York Mining Co. at Picher, Okla.

Non-metallic mines — Lower gypsum mine of the U. S. Gypsum Co. at Gypsum, Ohio.

Quarry and open pit—Security quarry of the North American Cement Corporation at Security, Md.

NATIONAL EXPOSITION COAL MINE EQUIPMENT

The Exposition Which Will Again Be Held At Cincinnati In Conjunction With Convention Of Practical Operating Men, Will Be Of Outstanding Importance—One Hundred Exhibitors Will Show Equipment Worth More Than Million Dollars

Ahlberg Bearing Co., Chicago, Ill. Booth No. 27

Ahlberg ground ball bearings which are reclaimed bearings. Also new bearings for new equipment and for replacing old bearings. These reclaimed bearings show a great saving in equipment.

A. Leschen & Sons Rope Co., St. Louis, Mo. Booth No. L-228

Wire rope, aerial tramways.

Allen & Garcia Co., Chicago, Ill. Booth No. 11

Coal screening and preparation machinery, picking tables, etc.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Booth No. 90

Various types of coal mine machinery and equipment.

American Car & Foundry Co., Huntington, W. Va. Booths No. 38 and No. 39.

Mine cars are of several kinds. Pressed steel backbone—large capacity at low heights.

American Rheolaveur Co., Wilkes-Barre, Pa. Booth No. 92

A small-sized section of a Sealed Discharge Launder with two small Sealed Discharge Rheo boxes. One small-sized section of a Free Discharge Launder with two or three small-sized Rheo boxes. One full-sized 14-inch Free Discharge Rheo Box. One full-sized 20-inch Sealed Discharge Rheo Box.

American Rolling Mill Co., Middletown, Ohio. Booth No. 93

Old Armco Ingot Iron mine car end gate (with full record of service life. Exhibits of Armco Ingot Iron galvanized and blue annealed sheets for mine car and coal mining installations. Enlarged photographs of Armco installations under coal mining conditions. Actual service life testimonials.

Atlas Lumnite Cement Co., New York City. Booth No. 58

A display of Lumnite cement which makes full strength 28-day concrete within 24 hours.

Atlas Powder Co., Wilmington, Del. Booth No. 12

General line of explosives, including all types of blasting powder used in mines.

Automatic Reclosing Circuit Breaker Co., Columbus, Ohio. Booth No. 22

An alternating current magnetic switchboard to use with a 150 H. P. 2,200 volt alternating current synchronous motor driving a 150 K. W. 220 volt direct current generator, this combined with the equipment of Cutler-Hammer Co. and Ridgway Dynamo and Engine Co. for a complete automatic substation.

Bennett & Myer, Inc., West Jefferson, Ohio. Booth No. L-224

Wood pumps of various kinds and mine doors.

Bethlehem Steel Co., Bethlehem, Pa. Booths No. 119 and No. 120

Mine ties, manganese frogs, rail templets, rail clamps, steel sprag, coupling link, pins, steel ties, etc.

Broderick and Bascom Rope Co., St. Louis, Mo. Booth No. 32

Wire rope and aerial tramway exhibit.

Carnegie Steel Co., Pittsburgh, Pa. Booths No. 42 and No. 43

Carnegie steel mine ties, steel cross ties, rails, mine timbers, wheels, axles, and other accessories.

Centerville Foundry & Mfg. Co., Centerville, Iowa. Booth No. L-225

Lodwick reversible mine fan. When the doors are shifted, the fan is reversed. Lodwick long wall shaking coal conveyors.

J. C. Wilson, The Ohio Brass Company, Chairman, The Manufacturers Division of The American Mining Congress

Central Frog and Switch Co., Cincinnati, Ohio. Booth No. 77

Frogs, switches, turnouts, switch stands in variety, steel ties, extension points, handy rail clamps, etc.

Chicago Pneumatic Tool Co., New York City. Booth No. 19

Little Giant Electric Coal drills mounted, unmounted and flame proof. Rock drills and pneumatic and electric tools.

Cincinnati Electrical Tool Co., Cincinnati, Ohio. Booth No. 99

Various types portable electrical coal drills.

Cincinnati Mine Machinery Co., Cincinnati, Ohio. Booth No. 36

A complete line of their machines.

Coal Mine Management, Chicago, Ill. Booth No. 30

Reception booth and display of publication.

Coloder Co., The, Columbus, Ohio. Booth No. 101 and tent

A full-size track-mounted "Coloder," Type C, in full operation in tent.

Concordia Electric Co., Pittsburgh, Pa. Booth No. 64

Electric Safety Cap Lamp. Approved by the U. S. Bureau of Mines for safety, practicability, and efficiency. Trip lamp. The only Trip Lamp approved by the U. S. Bureau of Mines. Shotfirer. Equipped with an Electric Storage Battery employing the dry electrolyte feature. Electric Safety Hand Lamps, Inspector Lamps, Watchman Lamps with dry electrolyte battery, Locomotive Lamps, and various other types.

Conveyor Sales Co., New York, N. Y. Booth No. 100

The exhibit of the Conveyor Sales Co., Inc., sole American agents for Eickhoff Brothers of Bochum, Germany, will consist of the following: A working model showing twelve (12) conveyor troughs of Eickhoff design transporting coal and other material up a 6½ to 14 percent grade. The troughs being so arranged that the material handled continuously "loops-the-loop." A full-size section of each of the various sizes of conveyor troughs. Photographs, descriptive literature, etc.

Cutler-Hammer Co., Milwaukee, Wis. Booth No. 24

An alternating current magnetic switchboard designed for use with a 150 H. P. 2,200 V. alternating current synchronous motor driving a 150 kw., 220 volt direct current generator, both manufactured by the Ridgway Dynamo and Engine Co. Associated with this panel will be a similar one manufactured by the Automatic Reclosing Circuit Breaker Co., the switchboard as a whole, together with the moving machinery, forming the Ridgway type automatic synchronous motor generator substation.

Dravo-Doyle Co., Pittsburgh, Pa. Booths No. 3 and No. 4

Austin mine pump, Curtis automatic suction valve, Rogers "Go-between" feeder suspension clamp, Dusta control for centrifugal pumps, DeLaval Centrifugal Pump, DeLaval worm gear speed reducer, Dravo multipart check valve, repair parts, acid-resisting bronze.

Deister Concentrator Co., Fort Wayne, Ind. Booth No. 97 and tent

The booth is headquarters, but in the tent will be shown a full-size Leahy No Blind vibrating screen, also a No. 7 Deister-Overstrom diagonal deck coal washing table, both in operation.

Deming Co., Salem, Ohio. Booth No. 20

Mine-gathering pumps mounted on wheels and axles and stationary.

Eagle Iron Works, Des Moines, Iowa. Booth No. 84

A small working model of the Olson Cage, showing latest improvements, such as car stop and release, etc.

E. A. Kinsey Co., Cincinnati, Ohio. Booth No. 54

Several types mine equipment.

Edison Storage Battery Co., Orange, N. J. Booths No. 50 and No. 51

Heavy duty batteries, photographs, etc.

The Electric Railway Equipment Co., Cincinnati, Ohio. Booth No. 9

Overhead trolley line equipment.

Electric Railway Improvement Co., Cleveland, Ohio. Booth No. 73

A complete line of steel and copper weld rail bonds with samples actually

applied to rail sections. Copper and steel bonding rod. Portable arc welding and bonding equipments and accessories.

Electric Storage Battery Co., The, Philadelphia, Pa. Booths No. 7 and No. 8
Three illuminated oil paintings will be featured. These pictures depict the uses of Exide Batteries in the mining fields. In addition, Exide Batteries of various types will be exhibited in their entirety and cut away to show construction.

Enterprise Wheel and Car Corporation, Bristol, Tenn. Booths No. 110 and No. 111
Mine cars and roller bearing trucks.

E. I. Du Pont De Nemours & Co., Wilmington, Del. Booth No. 69
Blasting and sporting powders, dynamite, cartridges. Ventube for mine ventilation, etc.

Fairbanks-Morse & Co., Chicago, Ill. Booths No. 107 and No. 108
Various types of mine pumps and motors.

Frederick Iron & Steel Co., The, Frederick, Md. Booth No. 80
Model coal mine tipple, showing application of Frederick Separators, Frederick Centrifugal Pump.

General Electric Co., Schenectady, N. Y. Booths No. 15, No. 16, and No. 17
Mine locomotives, automatic sectionalizing switch equipment, line material, rail bonds, etc.

G. M. Johnson Manufacturing Co., Jeannette, Pa. Booth No. 98
Mine cages, check rails, car stops, car feeders, automatic safety devices, etc.

Goodman Manufacturing Co., Chicago, Ill. Booth No. L-223
Various types underground cutters, loaders, locomotives, etc.

H. C. McCullough Engineering Co., Pittsburgh, Pa. Booth No. 65
Various types mine equipment.

Hendrick Mfg. Co., Carbondale, Pa. Booth No. 66
Perforated Metal Screens. "Mitco Shur-Site" stair treads. Flanged Lip Screens. "Mitco" interlocked steel grating.

Hercules Powder Co., Wilmington, Del. Booth No. 5
Complete information on explosives, blasting supplies, and their uses. The Explosives Engineer.

Hulburt Oil & Grease Co., Philadelphia, Pa. Booth No. 68
Complete line Hulburt products.

Hyatt Roller Bearing Co., Newark, N. J. Booths No. 33 and No. 52
Bearings for mine cars, conveyor idlers and drives, mine fans, electric motors, all types of mine locomotives, and machinery.

Ironton Engine Co., Ironton, Ohio. Booths No. 102, No. 103, and No. 104
Storage battery locomotive and new line conveyors.

Jeffrey Manufacturing Co., Columbus, Ohio. Booth No. 60 and tent
Its machinery exhibit will be located outside in the rear of Music Hall and will cover more than 2,000 square feet of floor space. The following machinery will be shown: The Shortwaloader, combined cutter and loader. The Shearing Machine, a new type of machine arranged for vertical cutting and having two drills mounted on its frame. A 6-ton low-type gathering locomotive. The sectional conveyor, for carrying coal from face to cars. The Conveyor-Loader, a self-loading conveyor for use on long faces. Portable Conveyors, chain and belt types. Blower with tubing for supplying air to the working face. All of the above equipment will be operated. At Booth No. 60 a moving picture will be operated to show various Jeffrey Machines at work inside the mine.

John A. Roeblings' Sons Co., Trenton, N. J. Booth No. 6
Wire rope samples and fittings.

Joseph H. Ryerson & Son, Inc., Chicago, Ill. Booth No. 26
A complete service in all kinds of steel, rails, structural, plates, bars, shapes, bolts, etc.

Joy Manufacturing Co., Franklin, Pa. Booth No. 67 and tent.
A full-size new 5 B. U. type loading machine in operation in the tent. Headquarters at the booth.

N. S. Greensfelder, Honorary Chairman, The Manufacturers' Division of The American Mining Congress

J. R. Fleming and Son, Inc., Scranton, Pa. Booth No. 21
Roller-bearing trucks, journal boxes, in numerous types.

Kanawha Manufacturing Co., Charleston, W. Va. Booth No. L-222
Working models of three-track coal tipple containing rotary dump, shaker screens, loading beams. Vibration screen with feeder. Side dump for refuse disposal.

Keystone Consolidated Publishing Co., Pittsburgh, Pa. Booth No. 10
Coal and Metal Keystone Catalogues.

Keystone Lubricating Co., Philadelphia, Pa. Booths No. 78 and No. 79
Complete line of oils and greases, automatic lubricating systems. Systems for mine car wheels and other machinery.

Koehler Manufacturing Co., Marlboro, Mass. Booth No. 18
Safety mine lamps, the Wheat electric safety mine lamp, charging rack for lamp, charging panels, rectifiers and other equipment.

Lincoln Steel and Forge Co., St. Louis, Mo., Booths No. 71 and No. 72
Lincoln trucks for mine cars, self-aligning journal boxes. Lincoln automatic greasing machines for mine cars, hand greasing cabinets, and slide rail holders.

Link-Belt Co., Chicago, Ill. Booths No. 48 and No. 49
Complete equipment for handling, preparation and storage of coal.

Lorain Steel Co., The, Johnstown, Pa. Booths No. 112 to No. 116, inclusive
Mine car, sectional conveyor, belt face conveyor, mine post jacks, mine track work.

Mancha Storage Battery Locomotive Co., St. Louis, Mo., Booths No. 34 and No. 35
Various types of storage battery mine locomotives.

Mine Equipment Co., Pittsburgh, Pa. Booth No. 28
Tipples, shaker screens, loading booms, rotary dumps, car stops, cages, etc.

Mine Safety Appliances Co., Pittsburgh, Pa. Booths No. 117 and No. 118
Edison safety mine lamps, oxygen breathing apparatus, first-aid supplies, gas masks, resuscitation apparatus. Precision instruments, showing methane and other gas indicators and various other safety devices and apparatus.

Mining Congress Journal, Washington, D. C. Booth No. 121
Reception booth for delegates, copies of the exposition number, and other literature.

The Mining Safety Device Co., Bowerston, Ohio. Booth No. 53
Models of Nolan single and double horned Cagers and Feeders; Automatic Scale and Dump Feeder; Automatic Rotary Dump Feeder, cushioned horns, actual size. Photographs of installed machines.

Modern Mining, Pittsburgh, Pa.. Booth No. L-227
Coal trade publication.

Myers-Whaley Co., Knoxville, Tenn. Booth No. 59 and tent
The exhibit in the tent at the rear of the Exhibition Building will be one of its latest loading machines, namely, size No. 2-25. This machine is lower in height than any of the Myers-Whaley machines exhibited at previous expositions. It requires only 39 inches from the rail in moving around from place to place, and requires only 42 inches height from top of rail for operation. The machine weighs a little over 7 tons and is the latest development of the Myers-Whaley Shoveling Machine. The machine will be shown in operation under power. Headquarters for pictures, etc., at Booth No. 59.

National Carbon Co., Cleveland, Ohio. Booth No. 2
Carbon products of every description, carbon, metal, graphite, brushes, and contacts, welding rods, plates and paste, and especially carbon products used in the mining field.

Ohio Brass Co., Mansfield, Ohio. Booth No. 45
Full line of trolley line equipment; for mines, rail bonds, high tension insulators, electric arc welders, headlights and feeder line equipment.

Osborne Register Co., Cincinnati, Ohio. Booth No. 91
Patented metal scrip, scrip issuing registers, rapid change and counting registers.

Penn Machine Co., Johnstown, Pa. Booth No. 25
Rail bonds and repair parts for mining machinery.

Pittsburgh Knife and Forge Co., Coraopolis, Pa. Booth No. 109
Large variety of superior steel mining machine bits. Mine car hitchings.

Post-Glover Electric Co., Cincinnati, Ohio. Booth No. 83
P. G. Homanite Steel Grids.W-W. self-starters, asbestos wood products, etc.

R. D. Nuttall Co., Pittsburgh, Pa. Booth No. 87
Locomotive and mining machine gearing, trolley bases, wheels, harps, poles, etc. Heat treated and hardened gears of all designs.

Ridgway Dynamo & Engine Co., Cleveland, Ohio. Booth No. 23
This exhibit will consist of a 150 K. W. full automatic motor-generator substation in operation.

Roberts & Schaefer Co., Chicago, Ill. Booths No. 41 and No. 44
One full-sized Arms Air Concentrator with motor drive. The concentrator is an exact duplicate of those used in the commercial plants for cleaning nut coal and screenings, but no coal will be handled during the exposition. One Arms Horizontal Screen driven by motor. This screen represents the small size used in actual plants.

Robinson Ventilating Co., Pittsburgh, Pa. Booth No. 29
Several types of mine ventilating fans.

Rome Wire Co., Rome, N. Y. Booth No. 88
"Super-Service" cords and cables for mining and other heavy duty uses; also heavy cables for electrically operated shovels for strip operations.

Sanford-Day Iron Works, Inc., Knoxville, Tenn. Booths No. 61, 62, 63, 94, 95, and 96
The exhibit will consist of a model mine with cars running from drift and slope dumping over one tipple. Two full-size mine cars, one of the Automatic Drop Bottom design and one of our Whopper design. An electric power high pressure Grease Gun. Moving pictures of Automatic Drop Bottom cars in actual operation. Roller bearing wheels and trucks.

H. K. Porter, H. A. Buzby, and C. L. Herbster, Vice-Chairmen of the Manufacturers' Division, The American Mining Congress

Simons Paint Spray Brush Co., Dayton, Ohio. Booth No. 105
Low pressure syphon feed mechanical method of applying paint. Air compressors are of the portable type operated by electric motor or gasoline engine.

Simplex Wire & Cable Co., Boston, Mass. Booth No. 57
Various types of insulated wires and cables for mine use, including Tirex Machine and Locomotive Cables, Tirex Shot Fire Cable and Portable Cord, Bore Hole and Shaft Cable, Distribution and Feeder Cables, featuring especially Selenium Rubber now used on all Tirex Cables.

S. K. F. Industries, Inc., New York City, N. Y. Booth No. 40
A display of Skayef self aligning ball and roller bearings. A number of models showing the anti-friction qualities of S. K. F. marked bearings.

Streeter-Amet Weighing and Recording Co., Chicago, Ill. Booth No. 1
Automatic weight recording and indicating machinery for weighing moving loads.

Sullivan Machinery Co., Chicago, Ill. Booth No. 106
Photographic display of coal-mining equipment of various kinds, including undercutters, shearing machines, long-wall machines.

Templeton Kenley & Co., Ltd., Chicago. Booth No. 56
Simplex Ratchet Jacks 1 to 35 tons capacity. Jacks for track work, handling mine machinery and electric locomotives. New model five-ton pushing and pulling jack.

Timken Roller Bearing Co., Canton, Ohio. Booth No. 76.
Application of Timken roller bearings to mine cars, conveyors, line shafting, pillow blocks and various kinds of mine power and machinery.

Tool Steel Gear and Pinion Co., Cincinnati, Ohio. Booth No. 37
Gears, Pinions, Sprockets, special hardened and toughened by the tool steel process, crane-track wheels, conveyor wheels, hardened bushings, etc.

Una Welding & Bonding Co., Cleveland, Ohio. Booth No. 55 and tent
Complete exhibit of Una bonds and mine welding equipment. Practical demonstrations will be made in the tent in the rear of Exposition Hall.

The Watt Car & Wheel Co., Barnesville, Ohio. Booth No. 81
Mine cars, different types of trucks and other items.

Waverly Oil Works, Pittsburgh, Pa. Booth No. 31
Various types Waverly lubricants used in all types of mine cars and equipment.

Weinman Pump Manufacturing Co., The, Columbus, Ohio. Booth No. 89
A type LLB Ball bearing single-stage double-suction centrifugal pump for acidulous mine water. A self oiler mine gathering pump with glass plate over gear case and water cylinder to allow observation of the working of the pump in action.

Weir Kilby Corporation, Cincinnati, Ohio. Booths No. 74, No. 75, and No. 82
Standard types of mine rails, switches, frogs, turnouts, and many types of rail track and rail track accessories.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Booths No. 85 and No. 86
New permissible motor and control with gathering pump, as recently endorsed by the (*continued on page* 343)

Exhibits typical of the Exposition

"PATIENCE," THE REQUISITE WHEN CONSIDERING COAL

All Problems Are Being Dissolved By The Play Of Natural Economic Laws—Impatience Can But Interfere With The Work Of Nature

By GEORGE H. CUSHING

WHILE there is no disposition to meddle with the work of members of Congress touching the coal business—they are all adults; are in full possession of their powers and, can think for themselves—there is justification for, and timeliness in, this observation.

Patience is the most needed factor in the solution of any coal problems and the one most nearly lacking. The coal industry has solved all of its problems in past; if given time, it will even liquidate the effect of Government regulation during the war. What it is pleading for is time, freedom and opportunity to do its work naturally and thoroughly.

Daniel Webster once said something to the effect that the source from which springs many of our ailments is the belief that "*something ought to be done.*" Concerning the coal industry, that belief possesses the minds of many public men. If Webster was right, the source of our present and possible future coal ills is this militant belief that "something ought to be done." That is, what has interfered with the progress of human events in past, and what is interfering with the proper conduct of the coal industry today, is the impatience of a few. They yearn for quick results. They want—so they say—quick action. They want to do it now. Sometimes it is hard to distinguish between mere impatience—a nervous disorder—and an outcrop of egotism. When the display is in connection with the coal industry, it is doubly hard to distinguish between the so-called pressure of some real coal problem upon the public mind and the ambition of self-loving gentlemen to impress their own opinions upon coal trade processes. But, whether it is disgust with the necessarily slow progress of coal in certain directions or the breathless haste to express individual wills upon an industry, the one thing that is seriously interfering with coal is personal, private impatience publicly expressed. It is that element which injects the danger into any discussion of coal.

Even a cursory examination of any period in coal history will disclose that, in time, all problems—no matter how acute they seemed at the time—have been dissolved. Even those problems which, today seem to be the most acute are actually dissolving while we examine them. There hasn't been a single problem in coal in past that has not disappeared—in time. Always the solution was the natural one. Current problems are likewise disappearing—are giving place to a natural, and therefore, healthful, solution. The coal industry worked itself out of its troubles in past because it was not hindered by the free play of the impatience of others. It will work itself out of its present difficulties in that same way and only in that same way.

If one should listen to the prattling of the present-day crop of impatient souls, he would imagine that coal never had a problem before and, therefore, had never worked itself out of any difficulties. One would imagine that it has been an industry which always has enjoyed smooth sailing; that it lacks and has lacked intelligence because it never had a need to display any. With all possible deference to wise heads on very young shoulders, that is hardly a reasonable assumption. The coal industry, in this country, is at least a century and a quarter old. No business managed by mortals ever ran that long without problems and without solving them. It is even doubtful if any industry ever ran a week and a quarter—not a century and a quarter—without stumping its toe on a real poser. The wrong method of procedure pursued for a century and a quarter would have wrecked the industry long ago and would have ruined the country generations ago. The assumption, therefore, that we have had no problems is necessarily wrong. And the assumption that there have been no solutions of coal problems is incorrect on its face. It is worth while, therefore, in this hour of strident impatience to stop for a moment to consider what has been done and what is being done. Such a consideration may serve as a foil for some of the suggestions as to things that "ought to be done" in breathless haste.

There was a time when the impatient people of another day thought they saw ahead the likelihood that the supply of coal would become permanently short—that we might have a manipulated constant scarcity of coal. This was to be engineered for the benefit which such a situation would have upon the prices charged by the coal owners. That wasn't the recent war period, by the way, nor yet in the period following the war; it was years before the World War was thought of or dreamed a possibility.

That belief prevailed at the beginning of this century when we had a series of great consolidations, and when in the minds of such gentlemen as the late Senator La Follette, it seemed entirely possible that the railroads would control the future supply of coal. There was such a disturbance about this danger that we went to the point of enacting several statutes and of conducting a long series of investigations through the instrumentality of the Interstate Commerce Commission.

To avoid just such a possibility, Senator Elkins amended the commerce act to compel the railroads to give service to any coal mine which wanted to open. Representative Hepburn further amended the commerce act to divorce railroad and coal control, and Senator La Follette put through a statute prohibiting interlocking directorates. Those were the days of impatience with a "possible" interference with the free supply of coal. However, at that very time, we had under our soil far more coal than any other nation on earth. That coal was privately owned. And the people could not be prohibited from developing and selling what they possessed. The fear and the facts were, thus so violently at war that the fear became ridiculous. Still, in those days, it was quite a "problem."

In time—a very short time, at that—the coal supply became so abundant that today we believe we have the reverse problem. So our impatient souls declare that we have too much coal. But that is not particularly a new problem either. It isn't even a fresh problem because it has been with us for over 125 years. In fact it has exerted a *constant* influence upon the practices of the coal industry and will likely continue to do so for another century or two. It dictated, for one thing, a price of coal which has fluctuated from a little above what would mean bankruptcy for everybody to a little below what would be a profitable business for everybody. That, incidentally, is not a harsh price for any consumer to pay. And that price prevailed up to the beginning of the World War; it has prevailed since the strike of 1922. The only interlude in our history when that policy did not prevail was between our entrance into the World War in 1917, to the great strike of 1922—a very short period of time of five years, at the outside. The interesting fact is that the only costly and abnormal period in coal history is exactly coextensive with Government regulation.

At the moment, and in recent years, there is and has been a great discussion of the so-called labor problem in coal. As is the habit of the moment, this is

treated as though it had never existed until just now and is insoluble except by some kind of drastic political action. On the contrary, the coal industry has always had a labor problem. For the first 100 years of our coal history we produced coal with practically nothing but picks and shovels. The introduction of mining machinery came within the last 25 years. Therefore, during the first 100 years of coal history we produced coal entirely by manual labor. And, in that 100 years we developed from nothing to the largest coal producer in the world. Therefore, we had, in that period, the largest coal labor problem in the world. And, somehow, we muddled through that century without any regulatory body; without enslaving men—because they always had the liberty to go elsewhere, and without increasing the burdens upon the consumer. As a matter of fact, by manual labor we produced coal so cheaply that we got the lowest priced coal and hence the lowest cost power in the world. As a result, we are today the leading industrial nation of the world.

In the last quarter of a century we have had the introduction of two new factors in coal mining, namely, mechanical devices and the miners' union. These two things seem, on the surface, to have given us our so-called labor problem. However, 19 of those 25 years had passed before we ever had a general strike. And, in the five years which remained, we have had but two general strikes. When those two strike incidents are isolated out of a history of a century and a quarter of labor history, they are nothing to become excited about. Even if we venture deeper into the subject, we may find that the cause of those strikes is not inherent in either the introduction of machinery or the existence of the union. On the contrary, we will probably find that for the 19 years when there was relative peace, the union was led by such gentlemen as John Mitchell, John P. White, Tom L. Lewis, and a long line of others. Since the latter part of 1919, when we had the first nation-wide strike, the union has been under the dominance of Mr. John L. Lewis. Therefore, the history of a century and a quarter being considered we must conclude that the misfortune of the coal industry and the public springs from the elevation of Mr. Lewis to a conspicuous labor job.

Rather than this being anything to become impatient about, it is worth while to look at the other side of the picture and see how the nation is reacting to the dominance of Mr. Lewis. It is worth while to ask the question popular on the street: "Will the people let him get away with it?" The obvious answer is that by the play of natural forces, Mr. Lewis is being eliminated. And, this is the manner in which it is being done. There exists, and always has existed, that tremendous reserve of coal which is spread abundantly over 28 of our 48 states. The union has obtained a monopoly in only a few of those states—never so many as half. The great abundance of our coal reserve has been in the other states. When the people found that the union's rules and wages were too high and that coal could be obtained elsewhere, they went elsewhere to get it. In the last five years—the exact period covered by Mr. Lewis' dominance—the position of the union and the non-union fields has been exactly reversed. Formerly the union field supplied two-thirds of the coal and the non-union field one-third. Today, the non-union field supplies two-thirds and the union field one-third. That means that, formerly, the union miner had two-thirds of the work to do; today, the non-union miner has two-thirds of the jobs. The natural law operates inexorably and, therefore, the union miner, finding that he must choose between the union and work, is deciding out of consideration for the necessities of his family. So, the union field is becoming non-union. Thus we eliminate the union and with it the annoying policy of Mr. Lewis. Therefore, that problem is solving itself in the very short space of time of five years. This tremendous change has come merely because the people exercised their patience for what, in the life of a nation, is but an hour.

The foregoing are the outstanding examples; there are many others which could be enumerated. For example, there was once the question of the conservation, or, in other words, the most intense utilization of the coal itself. It is true that the coal operator has not done a great deal toward the solution of that "problem." However, that doesn't mean that because they ignored the subject, the whole topic has been neglected. On the contrary, concerns like the Semet-Solvay Company salvaged the by-products while coking the coal. Concerns like the Barretts have worked out the problem of making effective use of the tar. Concerns like the packing companies have worked out the problem of utilizing the ammonia. Chemical concerns have recovered a thousand products from the oils in coal. And, in recent years, the dye industry has duplicated Germany in getting all of our color out of 15 percent of what is in the coal tar. All this means is that the coal operators have been content to be mere quarrymen while others have reaped the monetary reward which comes from refining their product. But, in a national sense, there has been no loss merely because that money flowed into one pocket instead of into another; the nation still got all the benefits of the refinement of coal.

The railroads have led in the study of the economical use of coal. The public utilities companies helped the movement along. The manufacturers of equipment have produced both pulverized coal and burners for pulverized coal. The net result is that we have saved at least 60 million tons of coal a year. So, that problem, also, has been solved by the simple play of natural forces.

It may be true that the people don't know about all of these things because they have not had an official observer to report upon them and, maybe, even, to claim credit for them. Still, even though we do not glorify an individual by making him sponsor for a nation's program, the fact is that in all matters touching coal, there has been, and continues to be, amazing progress. It is even ventured that there has been more progress under competitive procedure than would have been the case if progress had been restricted to the capacity of some Washington bureau to comprehend it or to find time to permit it.

So, we land at the point from which we started. The one prime requisite to a proper consideration of the coal problem is patience. What we need is to give the industry time and freedom to work out its own problems in a natural way.

The Chesapeake and Ohio Railway Co. has just issued a small pamphlet dealing with the coals to be found on its lines. This pamphlet covers the New River District, the Kanawha District, the Logan District, and the Big Sandy District.

The O'Gara Coal Co. announces the appointment of Joseph D. Zook, for the past eight years vice president of the Nason Coal Co., Chicago, as vice president, effective April 1. To his new duties Mr. Zook brings a ripe experience, gained in the coal and railroad industries. His activities in the Nason Coal Co. have gained for him a wide acquaintance among steam and domestic coal buyers.

COAL EQUIPMENT

(*Continued from page* 341)

Bureau of Mines. A type 904-C motor will be exhibited. The armature will be partly stripped, the steel frame will be open so as to expose the internal windings and the ball-bearing housing on one end of the shaft will be removed; half of the coils are to be raised out of the slot to show the construction. Mine locomotive controllers, as well as contactors, a cable guide with steel insert, safety switches and parts will be shown.

West Virginia Rail Co., Huntington, W. Va. Booth No. 70

Light steel rails, joins and spikes.

W. S. Tyler Co., Cleveland, Ohio. Booths No. 13 and No. 14

Hummer screens, testing sieve, shakers and other screening machines, samples of wire screen cloths.

POTASH AND THE SOUTH

The Problem Of Extracting Potash From Our Deposits Has Been Attacked Seriously By Both Private And Governmental Agencies—No Process Has Been Evolved Which At Present Makes It Available In Competition With Foreign Production—Review Of Present Situation

By FRANK L. HESS

TO prosper the South must have potash this year, next year and each succeeding year.

Potash is essential and irreplaceable for most crops. There is no "just as good." You may fool people into buying breakfast food made out of peanut shells or toasted sawdust but can't fool a cotton-plant with a substitute for potash any more than you can fool a horse-fly with a hobby horse.

There is nothing particularly new in such statements but in these days of noisy insistance that we "face the facts," it is well that we consider some real facts concerning our bread and butter and our jeans.

Of the four great southern crops, cotton, tobacco, citrus fruits and tourists, the last will thrive on climate, but for the others fertilizers must be added. They must have phosphate, nitrate and potash—these three, but the greatest of these is potash.

Phosphate, the South can and does produce in abundance. The circumambient atmosphere is about three-fourths nitrogen, unfixed to be sure, but every thunder storm fixes some and delivers it free to the planter. Muscle Shoals has been placed in the South ready for the fixation job, and Uncle Sam has the fixed nitrogen laboratory at work finding out just how best to do it.

But as yet, although the South buys and uses more potash than all the rest of the United States, although its cotton, tobacco, and citrus fruits are products which especially need potash, and although as I expect to show, it is dependent on foreign potash deposits that are controlled by a trade combination directed especially at the United States, yet the South and most of the United States have no available known potash supplies.

Besides the South, the eastern states and the California citrus belt are also large users of potash and as lands are cropped longer the use of potash will undoubtedly grow.

Not only will the acreage on which potash is used increase, but the quantity of potash used per acre will also probably increase until it approaches the quantity used in Germany, and that small country uses nearly half of the German output.

Our use of potash is peculiarly agricultural, and about 95 percent of the potash marketed in this country goes into fertilizers, only about 5 percent being used in chemicals and miscellaneous uses.

At present so far as an American potash supply is concerned the South and most of the remainder of our country are largely at the mercy of a foreign combination formed to get every practicable dollar from us.

I propose to show a possible way in which the United States may develop potash deposits so that it will have the whip hand in the fixing of potash prices.

SOURCES OF POTASH

The potash used in this country comes almost wholly from Stassfurt, Germany, and Mulhouse, Alsace. Before the Great War we imported annually an average of about 200,000 short tons of potash contained in various salts for which we paid about $10,000,000, or roughly $50 per ton. With the beginning of the war in 1914, the price immediately jumped more than 50 percent to $82, and the potash cost an extra $3,000,000 over the price of 1913, but this was a small rise compared with the prices that followed.

A "potash hunger" came with the continuation of the war. The average price of contained potash in 1916 was $437 per ton. Great efforts were made in this country to isolate potash from brines, alunite, greensand, kelp, wood ashes, cement kilns and other sources, but in our best year, 1919, after four years of experimentation we were able to produce at almost five times the price, less than one-fifth as much as we imported in 1913, and we were held up badly on the price after the war. In 1920 we imported about 225,000 short tons (224,792) of contained potash for which we should have paid about $11,250,000, but because the potash was controlled in Europe we actually paid about $39,000,000, so that more than $27,500,000 was extracted from our pockets in that one year without an equivalent return.

CONTROL OF MARKET

The Stassfurt mines are closely controlled by a combination of the German Government and the mining companies. The Alsace mines are likewise controlled by the French Government and the Alsatian mining companies.

On August 14, 1924, German and French representatives of the potash industry signed an agreement for three years, retroactive to May 1, 1924, governing their exports to the United States, the largest buyer, and to Sweden. The market was divided, 62½ percent to Germany and 37½ percent to Alsace. prices were raised somewhat and in the spring of 1925 they were changed slightly.

They were, c.i.f. eastern ports, as follows:

Prices for potash shipped c.i.f. to Eastern United States ports

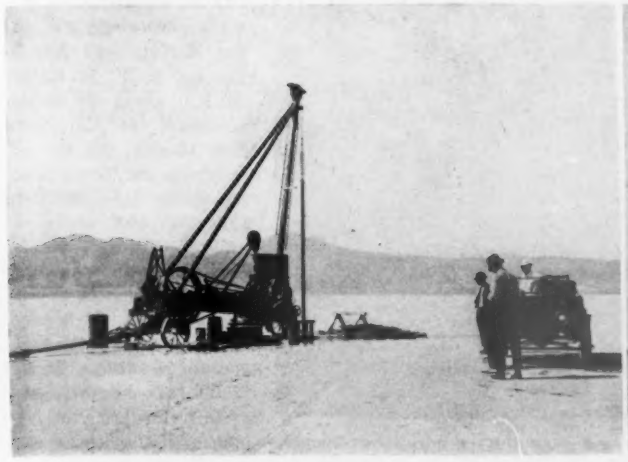
IN SHORT TONS

Substance	Before the combination	After the combination	Spring, 1925
Muriate, 80% K_2O..	$31.095	$34.55	$33.50
Sulphate, 90% K_2O.	41.265	45.85	44.60
Sulphate, 48% K_2O, in bags.....	.....	26.35	26.35
Double manure salts 48% K_2O, in bags	.....	26.35	26.35
Manure salts:			
30% K_2O, in bags	.....	19.03	19.50
In bulk	.....	17.03	17.50
20% K_2O, in bags	.....	12.55	13.00
In bulk	.....	10.55	11.00
Kainite, 14% K_2O:			
In bags	.....	10.25	10.25
In bulk	.....	8.25	8.25
Kainite, 12.4% K_2O:			
In bags	.....	9.75	9.75
In bulk	.....	7.75	7.75

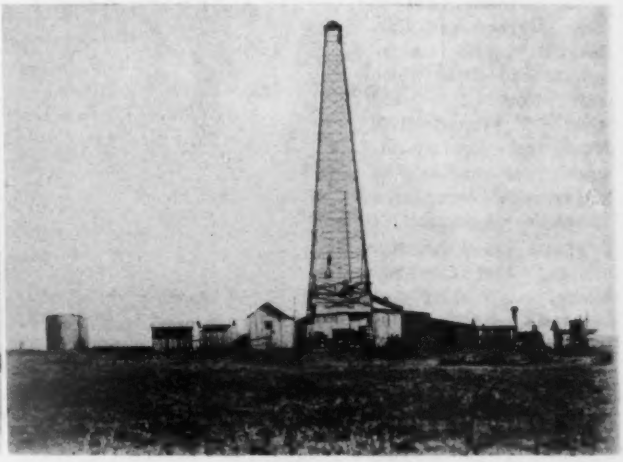
The present prices are not high, although probably well above the lowest price at which the companies could afford to ship. They represent what the combination thinks the traffic will bear without much encouragement to competition. But business concerns are not usually philanthropists, and with an air-tight combination below these prices we will have again those of 1920 at any time that the combination thinks it can get away with them.

SOURCES OF POTASH

Let me review briefly the present sources of potash. As already said, most of our potash comes from Stassfurt, near the Harz Mountains, in northern central Germany, where are enormous deposits of potash salts. No other known deposits of available salts approach them in size. Estimates of the potash available range from 2,225,000,000 to many billions of short tons. Taking the world's annual consumption of potash as 1,300,000 tons, then here alone is a supply that it is thought will last from 1,700 years to many thousands of years. The beds are irregular, but are as much as 500 feet thick. As mined, the ores apparently average from 8 to 11 percent of recoverable potash (K_2O). There are about 115 mines developed by about 218 shafts from 1,200 to 3,500 feet deep. Only between 60 and 100 shafts are operated, however, in order to make mining as economical as possible. It is estimated that the mines are capable of a production of 5,000,000 tons of potash per annum, and



Drilling through the salts of Searles "Lake." The surface of the "lake" is salt and is usually dry, but the salts form a sponge hundreds of feet thick filled with potash bearing brine



Drilling in the salt beds of western Texas. These are the largest known salt beds, and in them it is hoped to find large deposits of potash

that by using only 40 or 50 of the shafts with a proportionate decrease in overhead expense, the potash salts can be put on the American market at 35 percent less than present prices and still pay a profit to the producers. Possible utilization of the by-products may give more profit. However, wages in Germany, as in other places, are tending to rise, and may take the profit from these economies.

The owners of the Stassfurt deposits had little competition until 1910, when production was begun from other deposits that had been discovered in 1904 near Mulhouse, Alsace.[1] The Stassfurt owners bought into the Alsatian deposits before they became productive and with the assistance of the German Government a combination was effected which restricted output and consequent competition and stabilized prices.

Although the Alsatian deposits are not nearly as large as those of Stassfurt, they are said to underlie 70 square miles and to contain 357,000,000 short tons of potash (K_2O).[2] At the rate of 1,300,000 tons per year this is a world's supply for 275 years.

The potash beds are reached by shafts from 1,600 to 2,624 feet deep, and the mined beds of salts are from 5 feet to 18 feet thick with more or less clay partings. The beds carry from 15 to 33 percent of potash (K_2O). As mined the material necessarily contains more or less dirt and probably averages 18 percent of potash. The high content gives the deposits some distinct advantages over the Stassfurt deposits.

Deposits of soluble potash salts exist in Spain, Poland, Abyssinia, and other places, but they cannot compete, at least under present conditions, in our markets.

Domestic Production

We are the best customers for German and French potash. It isn't altogether a pleasant thought, that in 1925 we bought 251,000 short tons of foreign potash and that we produced in this great country only about 25,000 tons. Why did we produce so little? In reply, let me review very briefly our country's known potash resources.

So far we have proved no great soluble salt deposits like those of Stassfurt and Mulhouse, and our potash, except that from Borax Lake, has come from comparatively small deposits, carrying potash in easily extractable form, or has been produced as a by-product, and with our expensive labor all of the production has been costly.

Most of the known potash in this country is contained in minerals which hold the potash so tightly that so far no processes have been devised that will allow competition with the German and French production.

The mineral which is in greatest quantity and in greatest concentration is glauconite, or as it is often known, greensand. It is a hydrous silicate of iron and potassium which carries 6 to 7 percent of potash (K_2O), and is found in great quantity in uncemented beds from New Jersey southward through Delaware and Maryland to Richmond, Va. The potash is more loosely held than in most silicates, and plants can gradually extract it, so that it has been used direct as a weak fertilizer for many years.

G. R. Mansfield, of the United States Geological Survey, estimates that in New Jersey alone the potash of the greensand that is available for surface mining contains 257,000,000 short tons of potash.[3] Washington[4] estimates that, including those parts so deeply covered as to require underground mining, the beds contain about 2,240,000,000 short tons of potash. In Delaware, Maryland and Virginia are other great quantities, so that the potash in this one series of deposits would supply at the present rate of use, all the demands of the United States for 10,000 years. Here is a tantalizing problem—a quantity of potash comparable with that of Stassfurt, at the door almost within reach, but as yet only just touchable with the tips of our fingers. True, the percentage of potash is only two-thirds of that in the mined salts of Stassfurt, but the sand can be mined in the open air with power shovels.

The problem of extraction has been attacked seriously by both private and governmental agencies, but no process has yet been evolved that will make the potash available at costs that allow competition with the German and French supplies. When Alexander's men complained about the shortness of their swords he said "Add a step to them." Research may give us the added step that will put this stupendous quantity of potash within our grasp.

Leucite[5] and orthoclase[6] are other minerals which have attracted considerable attention to their potash content, and alunite was actually exploited during the very high prices, but no near approach to economic extraction has yet been made known.

Closely allied with orthoclase in their composition and in their potash content are various sericite schists and shales. In these also the potash is locked up with alumina and silica and if a key is found that will unlock one of the minerals it may unlock all.

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[1] Gale, Hoyt S. The potash deposits of Alsace. U. S. Geol. Survey Bull. 715, 1920, pp. 19-20.

[2] Loc. cit. p. 27.

[3] Mansfield, G. R. Potash in the greensands of New Jersey. U. S. Geol. Survey Bull. 727. 1922. p. 106.

[4] Washington, H. S. Italian leucite lavas as a source of potash. Chem. & Met. Engineering, vol. 18, 1918, pp. 65-71.

[5] Schultz, Alfred R. and Cross, Whitman. Potash-bearing rocks of the Leucite Hills, Sweetwater County, Wyo. U. S. Geol. Survey Bull. 512, 1912, p. 35.

[6] The dumps of the mines at Cripple Creek, Colo., contain 10,000,000 tons of finely crushed rock, largely orthoclase. They average between 5 and 6 percent K_2O and contain between 500,000 and 600,000 tons of potash.

In northern Georgia, near Jasper[1] and Cartersville[2] are sericite schists and slates which carry from 4.2 to more than 10 percent K_2O. These rocks form considerable outcrops and in the aggregate carry large quantities of potash.

Shales found in Minnesota,[3] Illinois,[4] Kentucky,[5] and Virginia[6] carry 4.5 to 8.0 percent of potash; and it is likely that many shales in the South carry as much.

Glauconite (green sand) exposed in a New Jersey pit. Glauconite beds along the Atlantic Coast contain enough potash to supply the United States for a thousand years, but it is nearly insoluble for plants

Besides the huge quantities of potash locked in the rocks of the United States, lesser quantities are found already in solution. These are in the brines of certain western "alkali" lakes.

The principal occurrence of this kind is Borax Lake, also known as Searles Lake, in the desert about 150 miles northeast of Los Angeles, Calif.

The brine which is held in a spongy mass of salts of various kinds and which seldom shows on the surface carries about 2.5 percent K_2O. It also contains 1.08 percent of borax and large quantities of salt, so that the by-products carry much of the cost of production. Most of the present production of potash in the United States comes from this lake. The lake may contain as much as 30,000,000 tons of potash, or a supply for more than 100 years at our present rate of consumption. The isolated location of the lake makes competition with European potash on the Atlantic and Gulf coasts practically out of the question at present prices. However it is at this time our principal protection from greatly higher prices.

The brines under the Salduro Desert, on the southwest side of Great Salt Lake, Utah, carry 0.33 percent K_2O, and some production was made from them during the war. Efforts have been made to again start production but it seems that freight rates will probably be prohibitive for a wide shipment of the salts.

A group of small lakes in the sand hills of northwestern Nebraska made our largest production of potash during the war, but the supply of brine is comparatively small and no considerable output can be made.

During the Great War many sources of potash were tapped at costs ordinarily prohibitive. Kelp on the Pacific coast; ashes from the waste of hard-wood mills, blast-furnace dusts, cement mill dusts, molasses waste, bitterns and others, were all made to yield their quota. Few of these efforts have survived the return to normal prices.

The natural tendency in such a contingency is to ask for a duty that will hold prices up to an artificial level approaching that of the war.

Much the better way is to develop if possible either an industry which can unassisted stand on its own feet, or to develop a potential industry which can be brought into being at any time that prices become too high. If such an industry can be developel it will be like an automatic pistol under one's pillow, and will be efficient protection for our pocket-books.

We have so far proved no great reserves of soluble potash salts in this country, but in a broad belt running from southwestern Texas and southeastern New Mexico northeastwardly across Oklahoma and into central Kansas is the greatest salt deposit known. The thick salt is fully 650 miles long and from 150 to 250 miles broad.[7] The Stassfult, Mulhouse, Spanish and Polish potash deposits are in just such huge deposits of salt and naturally our eyes have turned toward these beds as the possible location of other great potash stores. Holes drilled into the salt in search of oil have at various places shown more or less potash, but most of the showings have been in Texas. The richest discovery so far made, however, was in the McNutt well No. 1 (in sec. 4, T. 21 S. R. 30 E.), about 30 miles northeast of Carlsbad, New Mexico, and not so far from the Texas line. According to samples collected and analyzed by the United States Geological Survey, salts were entered at a depth of 1,734 feet which carried 9.16 percent K_2O and for a further depth of 156 feet the salts carried from 7.67 to 9.4 percent K_2O, with an apparent average of more than 8.5 percent K_2O. This is comparable with the average of the salts mined at Stassfurt. Potash was found in a well near the eastern edge of Borden County, Tex., about 140 miles east of the McNutt well, and the entire intervening distance is underlain by thick salt. It has also been found at points south and southeast of the McNutt well at least as far away, and a discovery was recently made 450 miles northeast, near Pratt, Kans. None of the other wells have, however, shown such rich salts as the McNutt No. 1.

Seven miles west of Thompsons, Utah, a well drilled for oil has taken out much richer potash salts at depths of 3,150 feet and 3,910 feet. The well caved so that the thickness of the salts is unknown. The rock salt in which the potash was found is reported as 2,000 feet or more thick. Other thick bodies of salt occur on the southeast in both Utah and Colorado.

In these great salt beds lies the principal hope for a large future potash supply. If the potash is there it can be located by drilling and drilling should be carried on in the immediate vicinity of such promising prospects as the McNut well No. 1 and of the well near Thompsons, Utah. It should also be carried on in other promising localities. The Texas field is not out of reach of the great consuming states of the South and the East, and other areas can be cared for from other deposits. The exploration for potash is a matter of public business insurance and the expenditure of public money to drill these lands is as necessary as proper, and as legitimate as is a man's expenditure for life, fire or automobile insurance.

Expense of Exploration

It is said that of the holes drilled for potash in Alsace only 17 percent were successful. Probably no greater percentage of holes would be successful in the proposed campaign, and drilling holes is expensive. (*Continued on page* 398.)

[1] Hopkins, Oliver B. A report on the asbestos, talc and soapstone deposits of Georgia. Geol. Surv. of Georgia Bull. 29. 1914. p. 355.

[2] Shearer, H. K. Report on the slate deposits of Georgia. Geol. Surv. of Georgia, Bull. 34, 1918, pp. 132 et seq.

[3] Schmitt, Harrison A. Possible potash production from Minnesota shale. Econ. Geol. vol. 19, 1924, pp. 72-83.

[4] Austin, M. M. and Parr, S. W. Potash shales of Illinois. Jour. Ind. & Eng. Chem., vol. 13, pp. 1144-1146 (1921).

[5] Ries, Heinrich. The clay deposits of Kentucky. Kentucky Geol. Surv. ser. 6 vol. 8, 1922, p. 6.

[6] Ries, H. and Somers, R. E. The clays and shales of Virginia west of the Blue Ridge. Va. Geol. Surv. Bull. 20, 1920, pp. 59, 85 etal.

[7] Darton, N. H. Permian salt deposits of the south-central United States. U. S. Geol. Sur. Bull. 715, 1912, pp. 205-223.

MODERN TENDENCIES IN POWER SHOVELS

Progress In Electrification Of Power Shovels Shows Remarkable Growth—Advantages Of Electrically-Driven Shovel Over Steam Discussed—High First Cost Justified By The Results Obtained —A Review Of The Growth Of the Use Of Power Shovels

By F. L. STONE*

THE electrification of power shovels has gone forward with such surprising rapidity that it would seem advisable to give the readers of the JOURNAL an idea of the present status of the development.

Power shovels, steam-engine driven, have been used very successfully for many years. The pioneer history seems to be somewhat incomplete. We will, therefore, pass over the early stages of development with the statement that the pioneers, whoever they were, must have been men of indomitable courage to attack such a problem. Even today, with all our experience and knowledge, shovel design requires the best engineering talent available. When one stops to consider the nature of the problem this will be very apparent. The shovel must meet all the extreme service conditions that can be imposed upon it with a minimum of shutdowns and a minimum of repair bills.

The first electrically driven shovel was in all probability one of the smaller types using one motor operating the various motions through clutches. The first shovel to be put in service which in any way resembles the modern electric power shovel was, so far as the writer can learn, a Marion No. 91, installed at the Empire Limestone Co., about 18 years ago. This machine had a 4-yard dipper and was of what is known as the "railway type." This means it was mounted on railway trucks and the boom and dipper only revolved through an angle of about 200°.

The electric equipment consisted of series railway type motors with contactor control operated from a 500-volt trolley circuit. These machines operated fairly well, but demonstrated clearly the fact that there were many inherent difficulties which would have to be overcome before a truly successful electric shovel could be produced. One of the outstanding troubles was the protection of the mechanical parts against heavy overloads. When the dipper went up against a load it could not move the driving motor would, if not automatically controlled, increase its torque until something gave way. To protect against this relays were introduced which would cut resistance into the armature circuit if the current went beyond a predetermined value. Unfortunately, however, the relay could not always operate fast enough, and as a result the damage was done before the relay got into action. This caused a very large amount of mechanical trouble, such as broken dipper racks, broken shafts, etc.

The control of these motors required a large number of contactors and a large amount of resistance, all of which tended to give trouble.

After a complete study of the problem was made it was decided that the only way a successful shovel drive could ever be built would be to design a drive which would have within itself a speed torque characteristic in which the speed would drop as the torque increased, carrying this curve to both zero speed and zero torque, and under such conditions the speed of the motors would not be beyond their limit of safety and the torque of the motors at standstill would not exceed the mechanical strength of the shovel parts.

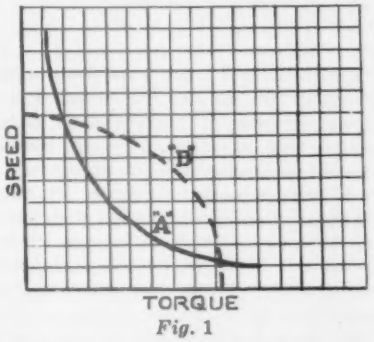


Fig. 1

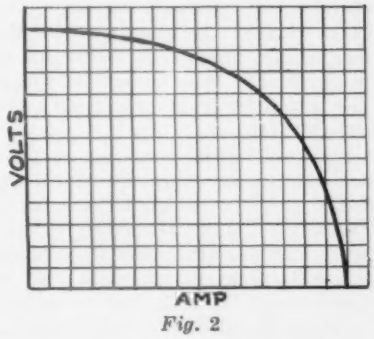


Fig. 2

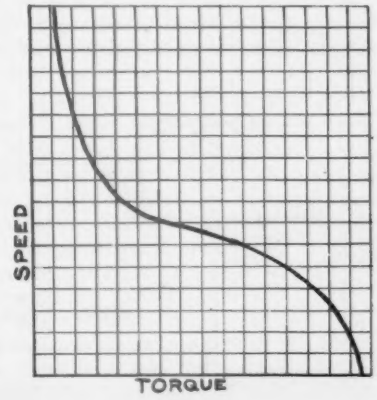


Fig. 3

The series motor run from constant potential circuit has these characteristics to a limited extent. Unfortunately, however, the series motor fails at both the extreme ends of the curve. On light loads the speed becomes very excessive and on heavy loads it will not stall but continues to develop an increasing torque as the speed falls until something gives way, provided, of course, the potential is maintained on the terminals.

Figure I shows the speed torque of a series motor with constant potential applied to its terminals "A" and also the most desirable shape of a speed torque curve for shovel work—"B."

From these curves it can readily be seen how the series motor, run from a constant potential circuit, could cause damage when applied to a shovel.

The induction motor has somewhat the same characteristic and is open to the same objection, together with many others. It might be in order at this point to explain, in a general way, why it is that induction motors have not been successful when applied to shovel drive. In fact, it would not be any great exaggeration to say that this application has been a failure wherever tried, provided the shovel is put into real work. In the first place, a large number of contactors is required per motor and the cast grid resistors for speed control require a very large amount of space which can not well be spared. The control is very jerky and lacks refinements found in the modern D. C. driven machines. The peak demands on the line are very excessive and the power factor is not good. The K.W.H. per ton is considerably greater on the A.C. driven machine. The mechanical maintenance is higher on the A.C. machines.

From the above it is obvious that the "time out" or delays for repairs on the A.C. machines is far in excess of that on the D.C. The only thing that can be said, now that they have had a thorough trial, is that they will run and dig material about as fast as the D.C. machine, and the A.C. drive is slightly lower in first cost.

It is quite significant that one of the

* Industrial Engineering Dept., General Electric Company.

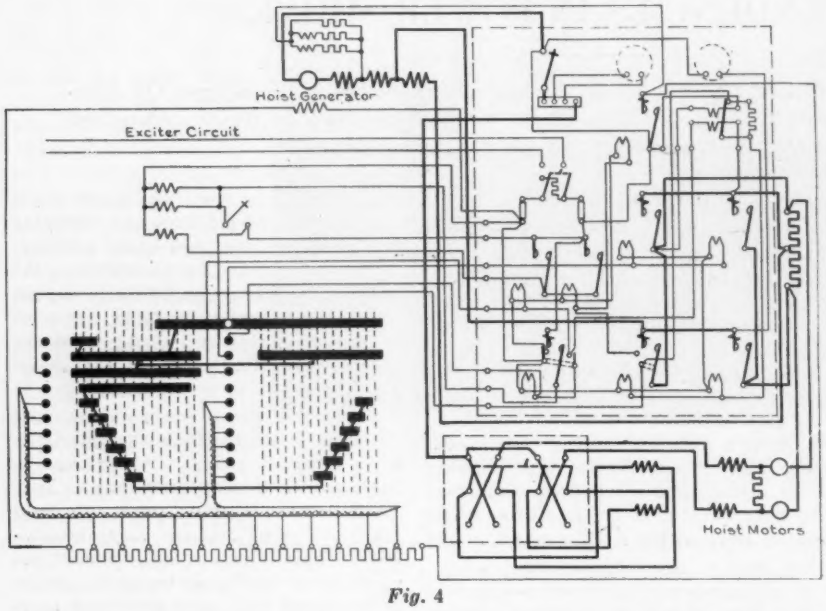


Fig. 4

large western mining companies who first purchased eight A.C. 4-yard railway-type machines have since purchased 13 D.C. equipments. This same condition exists at one of the large South American mines where considerable experience was had with A.C. machines, but all the recent purchases have been D.C.

It would seem that with the amount of evidence available, the question of A.C. versus D.C. drive for shovels is almost a closed book.

The first real step toward electrifying shovels was the adoption of a modified form of Ward-Leonard control. This necessitated a generator for each motor, together with a common exciter. On the earlier types the series motors were retained. The generators, however, were so designed that the voltage fell away with the increase of current and a volt-ampere characteristic was obtained approximately as shown in *Figure II*. This was a long step in the right direction. When series motors were operated from this type of generator a speed torque curve was obtained approximately as shown in *Figure III*.

The speed torque curve shown in *Figure III* was a very close approximation of the speed torque curve of the steam engine, which was considered about right for shovel work. A large number of machines were built in this manner and the results were very gratifying. The cost per ton of material dropped very considerably, and the shovel maintenance and continuity of service so improved that the electric shovel entered a new era.

Obviously space would not permit the smaller types, such as the ¾-yd., 1¼-yd., and the 1¾-yd. machines, to be equipped with a M.G. set carrying a generating unit for each of the three motions. The benefits derived from interposing a link between the line and the motors was so great, however, that on the small shovels a two-unit motor-generator set was installed, the generator of which was of sufficient capacity to drive all three motors. This generator has a drooping characteristic which comes into action when any one of the motors is seriously overloaded. Under normal operating conditions these smaller shovels act very like shovels whose motors are driven directly from a power supply. They have, however, the fundamental difference in that the M.G. is interposed between the line and the various motors. This set protects the equipment from serious abuse.

This feature of removing the main source of power from directly to the motors proves so beneficial that quite a number of shovels the motors of which were originally driven directly from the line with direct current have had installed a D.C. to D.C. motor-generator set which produced the desired result.

At first sight to one not familiar with the enormous power development in this country, it would seem that the field of the electric shovel is somewhat limited, but this is not at all the case, as it is hardly possible to find a spot on this continent where a shovel is called upon to work that power can not be obtained at a very reasonable cost. However, there undoubtedly are such places, particularly in cities, where it may be difficult to get the proper voltage and frequency to suit an equipment. To meet this demand, shovel builders have for the smaller sizes, ¾-yard and 1¼-yard, a very satisfactory gasoline engine generator unit. This is installed in place of a motor-generator set and these equipments are giving a wonderfully good account of themselves.

On the large shovels with the Ward-Leonard control and series motors some operating troubles developed, the principal one of which was the complication involved in securing regenerative braking to slow down. In order to understand this clearly, the winding of the generator fields must be kept in mind. This generator field carried three windings—a separately excited shunt field, a self-excited shunt field, and a differential series field. With the series motors the direction of rotation was controlled by four contactors in the series field.

When it was desired to stop by moving the controller beyond the off position into the reverse position, this reversed the series field of the motor while the armature was still rotating in the original direction. The tendency was for the motor to build up as a generator and send current through the driving generator of the M.G. set. This current, passing through the series field, which was normally differential, changed its effect into that of an accumulative field. Thus, we had two generators shorted upon each other with their induced voltages in series. Under this condition it was extremely difficult to control the amount of current which circulated, and a very jerky action sometimes resulted. Various schemes were tried to improve this condition, with more or less success.

The reversing contactors above referred to sometimes gave trouble, due to the excessive vibration of the shovel.

Notwithstanding the fact that the above layout was a vast improvement

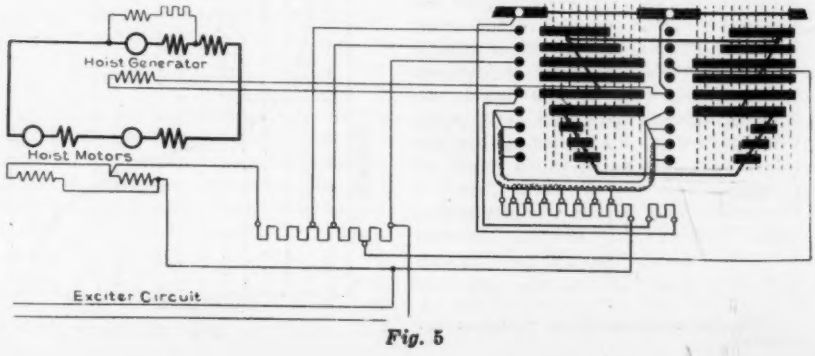


Fig. 5

10-cubic yard electric shovel, using D. C. motors and Ward-Leonard voltage control, operating in open pit coal mining

Full revolving type with 4-cubic yard dipper, D. C. Ward-Leonard type electrical equipment, New York Trap Rock Corp., Ver Planck Point, N. Y.

over anything that had gone before, the troubles above referred to led us to again attack the problem. The solution arrived at was the adoption of shunt-wound motors and the elimination of all control contactors.

It was fairly obvious that if such a system would meet the speed torque conditions, it would go a long way toward solving the great majority of the above problems.

It was found, after some experimenting, that by properly adjusting the fields of the generator and by equipping the motors with a special shunt field the handling was far superior to the series motor machines, and all the speed and torque that was necessary could be obtained.

Today we have shovels in sizes from the 1¾-yard dipper up to and including a 12-yard dipper machine, all equipped with Ward-Leonard control—machines without any control contactors. This set up allows the operator the greatest possible latitude. He can throw the controller from the off position to full speed in either direction at any rate of speed or from full speed one direction to full speed the other direction with absolute safety. The control of the current is entirely automatic. To give some idea of the extent of simplification, the diagrams shown in *Figure IV* and *Figure V* are included, *Figure IV* being the hoist control with series motors and *Figure V* the same with shunt motors. Here you see, in the modern large shovel, the generator and motors are tied solidly together. This produces an equipment which is as nearly fool-proof as it is possible to make a device of this kind and still have it function properly.

Having brought the electrically driven shovel to its present stage of development, the question naturally arises: "Wherein is it superior to its predecessor, the steam shovel?" The cost per cubic yard is the factor which most vitally interests all operators; this cost, of course, including all features properly chargeable thereto. The electric shovel is more expensive in first cost than the steam shovel, and there must be some good justification for its use. It is very difficult to secure absolutely parallel costs on electric shovels as compared with steam operating under exactly identical conditions. Such data as have been obtained show such a decided saving in favor of the electric that the higher first cost is more than justified.

There are certain obvious savings in favor of the electric as compared with the steam, such as the elimination of firemen, craners, the expense of handling fuel, and the maintenance of water lines, which in many localities is a decided hardship.

In regard to actual costs, we fortunately have some records which should be conclusive. R. S. Walker, consulting engineer of the M. A. Hanna Co., of Cleveland, states: "Power cost has averaged approximately one-half cent per cubic yard, as compared with 2½ cents per cubic yard fuel cost for the steam machine." Mr. Walker further states that the maintenance over a period of four years averaged below $5,000 per year for a Model 350 Marion electric, while the maintenance for a steam machine of practically the same size over the same period showed an average of approximately $25,000 per year.

In an article by R. C. Fisher and H. G. Head, describing the operation of electric and steam machines at the Michigan Limestone & Chemical Co.'s plant in northern Michigan, they show a total cost per yard of the electric to be approximately one-half that of the steam.

These savings, when converted into dollars over a year, provided the shovel is busy, run into very large figures, which wipe out the difference in first cost many times over.

EXPERIMENTAL BLAST FURNACE

THE experimental blast furnace maintained by the Bureau of Mines at its North Central Experiment Station at Minneapolis has been developed to the point where it is now possible to undertake the solution of special problems. One of these problems is the efficient utilization of the manganiferous iron ores on the Cuyuna range and in other parts of the country. These ores are very important because of the limited supply of domestic manganese reserves. While it is the practice at a number of plants to add small amounts of maganiferous ores to blast furnace mixtures, there is some question as to the practicability of smelting a charge containing 100 percent of these ores.

It is desirable to know whether it is commercially feasible to use these ores; and if so, what grade of metal can be made from them and what type of slags will give the highest recovery of manganese. More alumina occur in these ores than in straight Lake iron ores. This fact raises a question regarding the smelting of these ores. There has been considerable speculation regarding the effect of the rather large amounts of combined water present in Cuyuna range ores.

During a recent test about 136 tons of metal were made by the Bureau of Mines in the course of 34 days' operation of the experimental blast furnace. This test was designed to cover the important phase of the problem outlined above. The results obtained will be studied to determine whether they are complete enough to permit of drawing conclusions as regards recommending a commercially feasible process for the utilization of these ores. If this is not possible, further experiments will be made.

POTASH FINDS IN NEW MEXICO AND TEXAS

Government Has Withdrawn Seven Million Acres Of Public Lands In New Mexico, Said To Contain Potash Deposits—Description Of This Territory And Its Possibilities As Potash Producer Issued By Survey

WITHDRAWAL of 7,000,000 acres of public land containing potash in New Mexico has been announced by the Conservation Branch of the Geological Survey, following discovery of what promises to be a thick bed or group of beds of potash salts in Eddy County. The region, described in a recent report of that bureau, adjoins and is in fact part of the great potash field of western Texas, in which many discoveries of potash have already been made, as previously announced. In western Texas, as a result of the discovery of commercial pools of oil, there has been increased drilling activity, especially in the southern part, where over 50 strings of tools are now at work. Information on potash has come in larger measure from Reagan, Upton, and Crane Counties, but wells in other counties south of the thirty-second parallel and east of Pecos River are also showing favorable percentages of potash. The analyses cited below show the amounts of potash (K_2O) in the samples as received at the Geological Survey; the amounts in the soluble salts contained in the samples are generally higher.

The New Mexico discovery was made in connection with well No. 1 on the McNutt permit, in sec. 4, T. 21 S., R. 30 E., New Mexico meridian, 20 miles east of Carlsbad. Sixteen samples of cuttings taken from this well at depths of 1,033 to 1,890 feet yielded an analysis potash (K_2O) in amounts ranging from 1.35 to 9.40 percent. Five consecutive samples taken at different places in the 156-foot interval between depths of 1,734 and 1,890 feet constitute the most continuous series of samples carrying unusual percentages of potash yet obtained in the Permian salt basin. The samples do not, however, represent consecutive bailings. For example, only one sample was taken from the 111-foot interval between 1,771 and 1,882 feet. This sample, which contained 8.5 percent of potash, probably came from about the last 15 feet, or from a depth of about 1,867 to 1,882 feet, and was doubtless considered as representing the entire 111-foot interval. It is obvious that such a sample is not truly representative, for it is hardly to be expected that so great a thickness of beds would yield so high an average percentage of potash. The other four samples of the series were taken at intervals of 8 to 11 feet and contained potash in amounts ranging from 7.67 to 9.4 percent. The sample from the interval 1,302 to 1,310 feet contained sylvite; the rest of the samples had no other potash salts than the usual polyhalite. The occurrence of sylvite in this well is interesting, because it represents the first discovery of this mineral in the potash field of western Texas and New Mexico. Sylvite is the principal potash-bearing mineral of the Alsatian potash field in France and is much richer in potash than polyhalite.

The Texas discoveries were made in connection with seven wells, namely, Texon Nos. 2 and 3, Group 1, and Santa Rita Nos. 7, 8, and 9, in southwestern Reagan County; the Virginia-Texas University No. 1 well, in Upton County, and the W. D. Johnson-Lockhart well, in Loving County. Of the 170 samples analyzed from these wells 89 have shown 1.5 percent or more of potash. Of these 89 samples 21 have yielded more than 5 percent and 3 more than 10 percent. The richest sample, containing 11.25 percent, came from a depth of 1,255 feet in the Texon No. 3 well. Another rich sample, containing 10.22 percent, came from the interval between 1,450 and 1,460 feet in the same well. A third rich sample, containing 10.42 percent, came from an interval between 1,355 and 2,405 feet in the Virginia-Texas University No. 1 well.

An interesting feature of these wells is that each of them has furnished suites of samples containing unusual amounts of potash. Thus in the Texon No. 2 well practically the entire series of 15 samples contained noteworthy amounts of potash, although the highest sample yielded only 5.4 percent. In the Texon No. 3 well the interval between 1,125 and 1,330 feet furnished 12 samples, of which only 2 contained less than 1.5 percent, and the others ranged from 1.64 to 11.25 percent. In the Santa Rita No. 7 the interval between 1,435 and 1,515 feet supplied 7 samples, of which 4 contained more than 6 percent. Two of these taken at 1,445 to 1,465 feet ran 7.95 to 8.22 percent, and two others at 1,485 to 1,515 feet ran 6.09 and 6.16 percent. A lower interval, 1,725 to 1,735 feet, yielded a sample with 8.05 percent. The Santa Rita No. 8 well furnished 35 samples, of which 17 exceeded 1.5 percent in potash content. Six samples were taken from the interval 1,235 to 1,310 feet. Five of these ranged from 4.21 to 5.92 percent, and the sixth contained 1.41 percent. Another group of five samples from depths between 1,470 and 1,570 feet ranged from 2.67 to 5.48 percent. In the Santa Rita No. 9 well consecutive samples taken between depths of 1,225 and 1,250 feet contained 5.65 and 5.7 percent of potash. Other intervals at 1,276 to 1,295 and 1,558 to 1,578 feet yielded samples with 5.85 and 5.12 percent, respectively. The Virginia-Texas University well No. 1, in block 15, sec. 14, is of interest because it shows the presence of potash in Upton County, which is intermediate in position between Reagan and Crane counties, where the occurrence of potash was already known. In this well four consecutive samples taken between 1,352 and 1,405 feet ranged from 2.03 to 7.58 percent in potash content, and another sample from the interval 1,445 to 1,455 feet contained 8.7 percent. Two samples were analyzed from the 50-foot interval between 1,355 and 1,405 feet. One of these contained 10.42 percent potash, and the other only 6.65 percent. The samples were much alike in physical appearance except that the poorer sample appeared to have been leached more than the other. The Johnson-Lockhart well, in Loving County, is interesting because the salt series appears at shallower depths than in the wells previously studied, traces of polyhalite having been found at 450 to 460 feet.

The results of the sampling above described illustrate some of the difficulties in obtaining information on potash from oil wells drilled with standard tools. The intervals at which samples are taken are more or less irregular but generally not less than 10 feet. Intervals of 20 feet are common, and some as great as 50 feet or even 111 feet have been noted. The samples have been churned about for some time in the drilling solution and have been modified from their original condition. They are thus not properly representative of the intervals from which they purport to come. If the intervals are 10 feet or more the identification of individual beds of possible commercial grade is impossible, because material from richer and poorer layers is jumbled indiscriminately in the sample. Moreover, in an open hole material from higher levels is doubtless frequently knocked into the hole and recovered with samples from greater depths, thus either enriching or impoverishing the samples. The numerous groups of consecutive samples showing noteworthy amounts of potash suggest the presence of relatively thick bodies of salts and associated strata, of which it may be possible by core drilling to distinguish individual beds of polyhalite rich enough and thick enough in themselves to be of commercial grade, or so distributed that they may be readily enriched by sorting. Until core-drilling methods are employed, however, it will not be possible to obtain definite information about the thickness and quality of individual beds.

FELLOWSHIPS OFFERED BY MINING SCHOOLS

Over Thirty Opportunities Offered Covering Wide Range Of Scientific And Practical Research

FOR the college year 1926-1927 more than thirty fellowships in eight institutions will be awarded students who desire a period of active training in research work along mining and metallurgical lines through agreements effected between the Bureau of Mines and various universities and colleges. The problems to be studied cover a wide range of scientific research. Many students who have received these fellowships in past years have, as a result, obtained remunerative positions in the industrial field. Detailed information in regard to the terms of the different fellowships can be obtained by applying to the authorities in charge of the educational institutions named below.

The School of Mines of the College of Engineering, University of Alabama, Tuscaloosa, Ala., offers five fellowships in mining and metallurgical research. The fellowships are open to graduates of universities and engineering schools who have proper qualifications to undertake research investigation. The value of each fellowship is $540.00 per year of nine months beginning September 1. The fellowships have been established for the purpose of undertaking the solution of mining and metallurgical problems of special importance to the State of Alabama and the southern states.

For the year 1926-27 studies of the beneficiation of iron ores will be undertaken, including the following phases:

Gravity concentration by means of screens, classifiers, jigs, tables, log washers, etc.; Reduction of iron ores by means of roasting furnaces; Magnetic concentration; Sintering of fine iron ore concentrates.

The Department of Mining and Metallurgy, College of Engineering of the Carnegie Institute of Technology, Pittsburgh, Pa., offers eight fellowships in mining and in metallurgical research, in cooperation with the Pittsburgh Experiment Station of the United States Bureau of Mines and Advisory Boards representing these industries. Fellowships are open to the graduates of colleges, universities, and technical schools who are properly qualified to undertake research investigations. Each fellowship carries a stipend of $750, paid in ten installments.

The following subjects have been suggested for investigation:

Origin and constitution of coal; Coal mining; Utilization of coal; Mine safety; Physical chemistry of steel making; Production of special steels and alloys; Metallurgical refractories.

The College of Mines of the University of Washington, Seattle, Wash., offers five fellowships for research in coal and clay. The fellowships are open to graduates of universities and technical colleges who are properly qualified to undertake research investigations. The value of each fellowship is $720, for the twelve months beginning July 1. The purpose of these fellowships is to undertake the solution of various problems being studied by the United States Bureau of Mines that are of especial importance to the State of Washington, the Pacific Northwest and Alaska. For the year 1926-1927 the following subjects have been selected for investigation:

Beneficiation of coal, including coal washing, and application of ore dressing principles to cleaning of coal; Utilization of coal, including the briquetting of low-grade coals; Washing of kaolin and fire clays; Problems in drying certain clays; Efficiency studies in kiln-heating.

The School of Mines and Metallurgy of the University of Missouri, Rolla, Mo., in cooperation with the U. S. Bureau of Mines and the State Mining Experiment Station, offers four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 per annum for the twelve months beginning July 1, 1926.

The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1926-27 the four fellowships will be granted in the following subjects:

Metallurgy of zinc: Refractories for Metallurgy of zinc; Physical Metallurgy (heat treatment of steel).

The University of Nevada, Reno, Nev., offers in the Mackay School of Mines a fellowship open to graduates of American mining colleges of recognized standing. The income of the fellowship is $750 a year, payable monthly. The holder of the fellowship will be required to carry a minimum number of graduate courses in the Mackay School of Mines and, in lieu of the usual thesis, will be assigned to research service with the United States Bureau of Mines Rare and Precious Metals Station located on the campus.

The Arizona Bureau of Mines, a subdivision of the College of Mines and Engineering of the University of Arizona, Tucson, Ariz., offers two fellowships in metallurgical and chemical research in cooperation with the Southwest Experiment Station of the U. S. Bureau of Mines. These fellowships are open to men who have obtained the equivalent of the Bachelor of Science degree from a recognized university or technical school, who have specialized in metallurgy or chemistry as undergraduates, and who are qualified to undertake research work. Each fellowship yields $660 for a period of eleven months, beginning July 1. The purpose of the fellowships is to undertake the solution of metallurgical problems of special importance to the Southwest. For the year 1926-27 the subjects to be investigated will be selected from the following list:

Losses in smelting; Production of copper from concentrate by leaching; Recovery of copper from impure dilute solutions; Treatment of by-products in copper smelters; Treatment of pyrite middling in copper concentrates; Treatment of oxidized copper ores containing gold and silver.

The Department of Mining and Metallurgical Research, University of Utah, Salt Lake City, will award several fellowships, each having an annual net value of $720. This Department is maintained in connection with the Intermountain Experiment Station of the United States Bureau of Mines.

During the year 1926-27, the problems to be investigated are:

Flotation; Hydrometallurgy of zinc; Hydrometallurgy of lead; The recovery of lead from mixed lead-zinc carbonate ores by calcination and gravity separation; Differential sulphating of complex ores and concentrates to facilitate subsequent separation by milling or leaching; Pyrometallurgy of lead.

The School of Mines of the University of Idaho, Moscow, Idaho., in cooperation with the U. S. Bureau of Mines and the Idaho Bureau of Mines and Geology, offers a number of fellowships open to college graduates who have had good training in mining, metallurgy or chemistry, and who are qualified to undertake the research work. The net income of each fellowship over and above all University fees and deposits is $60 a month for ten months beginning September 1, 1926. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Idaho. For 1926-27 the following subjects are being considered:

Research on classification in relation to the crushing and concentrating of ores; Studies in gravity concentration; Idaho ore problems; Flotation concentration.

COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Coal Mining Industry

ROOF CONTROL IN PILLAR WORK WITH MECHANICAL LOADING

A Description Of Results Obtained At Pocahontas Fuel Company, Where Twenty-Three Million Tons Of Coal Were Standing In Room Pillars, When Mechanical Loaders Were Installed—Speed Of Recovery Is Real Secret Of Success In Pillar Drawing

By EDWIN H. JOHNSON*

THE Pocahontas Fuel Company had 23,000,000 tons of coal standing in room pillars when their first Coloder was put to work. Pillar coal had been more expensive than room coal until that time, so the room pillars were sometimes allowed to stand for years before recovery was begun.

The original mining practice was room and pillar, 18-ft. rooms on 60-ft. centers, leaving a 42-ft. pillar. This has lately been changed to 18-ft. rooms on 80-ft. centers. This concedes the fact that pillar coal has now become the cheaper of the two.

Roof conditions at these mines vary widely. Some sections show a true draw-slate which falls with the coal. Others show a cap-rock of sandy shale which parts readily from the stratum above and for safety is taken down after the coal is loaded out of a cut. Other places have roof coal left in the first mining. Also there are many sections having a firm shale top. The overlying strata are much the same. These consist of alternate shale and sandstone layers without much lateral strength. Because of the rugged nature of the country, the thickness of the cover varies sharply.

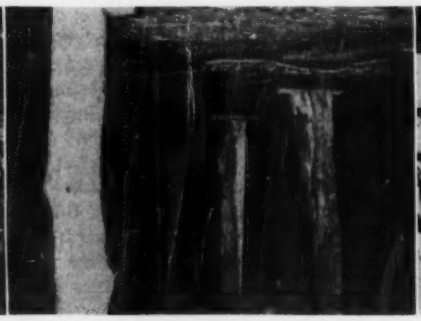
The loading machines operate under the same conditions of mining as do the hand loaders in pillar drawing. Splits are driven across the room pillars parallel to the break throughs and the wing is cut into stumps.

In hand loading the weight of the roof crushes the stumps badly and necessitates the placing of extra props and cross bars at the working places and in the adjoining room headings. Working places are often timbered three times, and some of the stump coal is not recoverable. The difficulty of recovering stump coal is considerable where the coal is 9 or 10 feet thick. Failure to get all the coal results in loss of timber and in frequent over-riding weight along the pillar line.

Using mechanical loaders, the company gets nearly all of the coal. There have been 200 or 300 tons of coal in single stumps which were recovered by a machine in a single shift. None of

* Mining Engineer, 568 N. 43d St., Columbus, Ohio. Fellow, Carnegie Institute of Technology on "Mechanical Loading in Coal Mines," 1924.

Coloder working a stump, Pocahontas Fuel Co.



Rib line before pulling the props

Letting the machine do the work

these working places ever has to be timbered more than once. In saying that nearly all of the coal is recovered, it is meant that usually none of the coal is left touching the roof when a stump is taken. The sound props are recovered and reused. Since nothing is left in the gob to cause a swinging weight, the falls are complete and little crushing is experienced at or near the rib line.

The small number of props in use is commented upon by visitors, who admire the working conditions. These visitors later find that the same roof will exhibit other characteristics under hand-loading conditions.

Speed of recovery is the real secret of success in pillar drawing, for only by application of rapid loading is complete recovery likely to be possible with room and pillar mining in this field. This is illustrated by an experience often cited by the officials of this company. A certain section of a mine had suffered a general squeeze, so dangerous that miners were withdrawn and the section abandoned. After some months had passed Coloders were started into this section. Gangs were kept busy relaying tracks in entries where the creep of the bottom had heaved the roadways out of shape. Under careful supervision, with double-shifted operation the pillar line was reopened; the squeeze was stopped; and thousands of tons of coal were recovered which otherwise would have been lost.

Figure I illustrates a typical section of the No. 3 Pocahontas seam and the nature of the strata which overlie it. None of the overlying measures are so tough or massive that much difficulty is experienced in breaking the roof. Faults are infrequent and not of great importance.

In all of the theories regarding roof action, authorities are agreed upon one principle. The failure that occurs along a breaking line is a progressive action which begins as soon as any of the coal is removed. Some subsidence results when rooms are driven before any robbing is done. This means that at some point above the coal a zone of weakness has developed, permitting a separation of the stratified layers of rock. When the robbing starts the subsidence continues and these partings become more frequent, extending for some distance into the coal barriers or room pillars. When the coal is nearly all removed the increasing tension in the bottom layers results in failure and roof falls occur. Subsequent breaks result from the shearing of the lower layers by a progressive cantilever action.

The point in this reasoning that interests the mine official is the progressive nature of the elements of roof failure. Exposure of these measures to humid mine air results in some decomposition of

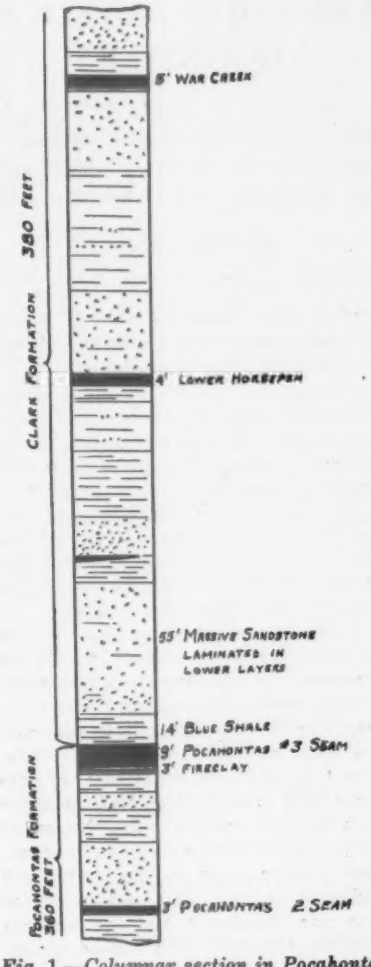


Fig. 1.—*Columnar section in Pocahontas quadrangle*

the strata which hastens the breaking action. However, all of these forces take time. Few examples of mining practice serve better to illustrate this fact than the mines in the No. 3 Pocahontas seam. Taking out a stump or the wing of a room pillar in one shift rather than in a week or two weeks will make a good roof out of a bad roof *by keeping ahead of the roof action.*

Figure II shows a system of recovery by working diagonal faces off the ends of room pillars in Cherokee and Delta mines, in Cherokee by hand loaders, and

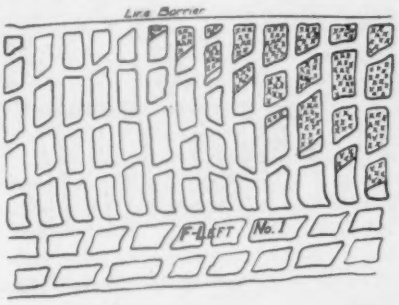


Fig. 2.—*Diagonal pillar faces at Cherokee Mine*

in Delta by Coloders. The physical conditions are much the same in both mines. At Cherokee the height of coal is 66 inches with 6 inches of cap rock, while at Delta the coal is 72 inches with no cap rock or drawslate. The roof is supported by 8-in. props set 10 or 12 feet from the face.

At Cherokee mine the overriding weight crushes the face so that very little cutting or blasting is done. Of nine faces in operation, only two or three are generally at full extent because the falls often ride over the props and shut off the faces. When this happens a "skip" is driven through at the end of the pillar, next to the gob, to reopen the face. No props are recovered.

At Delta mine the faces are undercut and shot, since little or no crushing occurs at the face. The cut is loaded out in a shift, producing 90 to 100 tons. When loading is finished a new row of props is set and the props behind are pulled, about 40 percent of them being available for reuse. Faces are rarely lost.

The crushing of the coal mined from room pillars is responsible for the production of much small-size coal, particularly in coal beds of a friable nature. If it is possible to keep ahead of the crushing action or to avoid it an improvement in lump production may be expected.

COMMITTEE ON WOOD UTILIZATION MEETS

THE National Committee on Wood Utilization met Wednesday, April 28, at the Department of Commerce, following the conference on April 27 of the Central Committee on Lumber Standards. Problems of paramount importance, selected from the hundreds of suggestions received from the lumber industry, were considered.

The members of the committee represent manufacturers, distributors, and consumers interested in the handling and using of wood and wood products. Among the more important questions to come up for definite action was the marketing of short lengths, odd widths and odd lengths of lumber, small dimension stock, and preserved wood. Various phases of important by-product industries, such as wood chemicals, wood flour, charcoal, were considered. The pulp and paper industry was represented by a special delegation, this alone being an important field of activity for the committee to cover.

"Utilize wood and save our forests," is the slogan of the committee. The result of its work will be to impart better knowledge of efficient wood utilization and wood-using practices. Secretary Hoover is chairman of the committee, and the vice chairman is Colonel Greeley, Chief Forester of the United States.

MINING TWO COAL SEAMS SIMULTANEOUSLY WITHIN THE SAME BOUNDARY

Experience In The Mining Of Two Coal Seams Simultaneously Within The Same Boundary, In Northern Cambria County, Pennsylvania, With A Small Interval Between Them And The Methods Employed To Overcome Difficulties

By FRED J. HOGAN *

IN northern Cambria County, Pennsylvania, where two or more seams of workable coal exist, and where mining in two seams at the same time has been attempted, improper methods have been the source of many troubles and the cause of the loss of much coal. Much of the coal mined in this region is from mines on different seams with a small interval between them, and in many cases each seam is mined by a different company.

In the writer's experience in mining two seams simultaneously, many difficulties have been encountered and overcome. When mining of this character was started in this region the mines were laid out without regard for the mine in the seam above or below, as the case happened to be. It was not long until this practice was found to be the cause of trouble as well as the cause of the loss of coal. Then the plan of mining the lower seam before work was started on the upper seam was originated.

Where the lower seam is mined thoroughly—that is, where no pillars or stumps are left—this method has proven successful, especially in cases where both seams are controlled by the same company. But in cases where different companies mine the different seams, this method had to be modified in such a way as to permit both companies to carry on their mining without disturbance.

In one case where the mining was done in the lower seam without regard for the upper one considerable coal was lost in both seams. The mining in the lower seam was not thorough, pillars were split and small stumps were left which prevented a uniform subsidence of the strata, and caused the roof of the upper seam to break and the coal to become so badly crushed that neither hand nor machine mining could be done with any degree of safety. This section of the mine was abandoned, and the coal can never be recovered. This method of mining was pursued under a greater part of the upper seam and threatened the entire upper seam mine. Finally the owner of the upper seam, for self-protection, was forced to buy the lower seam mine.

As the upper seam was the most important one, pillar robbing in the lower seam was discontinued. Mining in the entries in the lower seam was continued while the mining in the upper seam over these entries was carried on without any difficulty. The upper seam workings were continued over the mined-out area of the lower seam, but with great difficulty and at a considerable extra cost. In some sections there was an almost continual subsidence noticed, which we attributed to the gradual crushing of the stumps left in the lower seam. Over much of this area there was a separation of the bottom from the coal or the coal from the roof, or in the coal seam itself, of from 1 to 8 inches.

In a portion of the area the coal in the upper seam was mined without the use of a mining machine; even hand mining was not necessary. The lower seam is 36 inches thick, with a fire-clay bottom 3 to 4 feet thick, and the upper seam is 38 inches thick, with a fire-clay bottom

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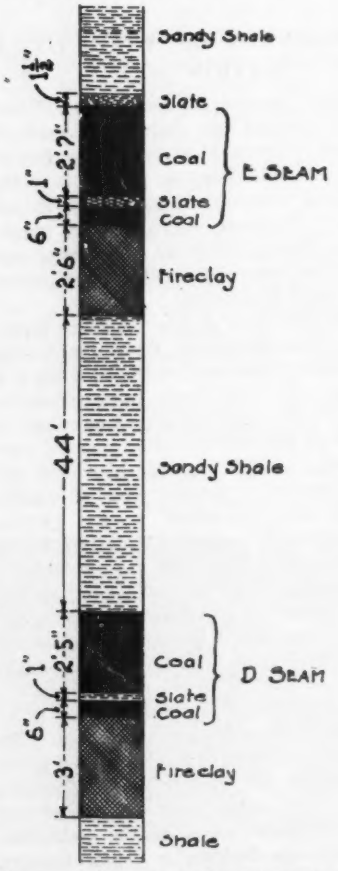

Fig. 1.—Columnar section of strata near Hastings, Cambria County, Pa.

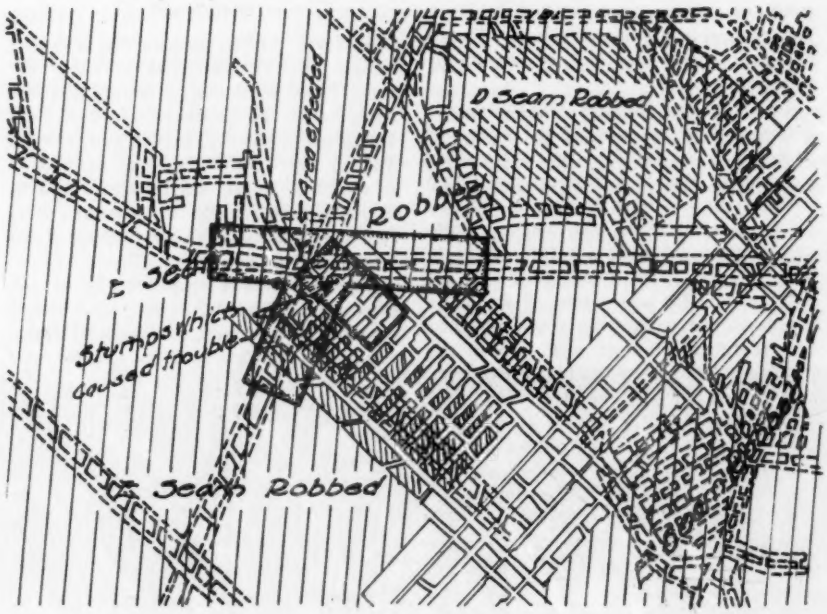

Fig. 2 - E or Upper Seam workings
D or Lower Seam workings
E Seam pillars Robbed when trouble occured

from 3 to 4 feet thick, and 20 feet of sandy shale for roof. *Figure I* shows a columnar section of the strata.

Many mining men are, erroneously, under the impression that mining in the upper seam will not cause trouble in the lower seam. The fact is that improper mining in either seam will do damage to the other one. In one instance of recent occurrence this fact was brought forcibly to our attention.

In this case the entries in both seams were driven simultaneously. After the entries in the upper seam were completed the rooms were driven. Up to this stage no disturbance was noticed in either seam. Robbing of the room pillars in the upper seam was then started, and a number of them were completely robbed before a disturbance in the lower seam was noticed. At this stage the coal in the lower seam along the ribs of the entries was falling off, the top was breaking, and the bottom was beginning to heave. As the mining in the upper seam continued the condition got worse, until, finally, the bottom heaved so badly that the mine locomotive could not pass through the entry. Timbers were broken and caves were a daily occurrence. This condition continued for several weeks, during which time men were constantly employed replacing timbers and taking up bottom. Props were set a foot apart across the entire width of the side entries, but were of no avail. Cribs about 4 feet square were then built in the side entries and along the side of the main haulage entry, but did not relieve the situation.

A thorough investigation revealed the fact that several blocks of coal in room pillars were left in the upper seam, which prevented a thorough cave. The strata above the upper seam broke and settled on the blocks of coal, which transferred the pressure to the lower seam. Immediately steps were taken to get these stumps out. Some of the coal was loaded into mine cars. Where mining and loading the coal was too dangerous, the remaining stumps were shot out with heavy charges of powder. In this way the stumps were sufficiently weakened to permit the places to cave.

The pressure was immediately released from the lower seam and has not given any trouble since. The interval where this occurred is 44 feet and consists of sandy shale and fire clay. The upper seam is 38 inches thick and the lower seam 36 inches thick. Each have a fire-clay bottom from 3 to 4 feet thick. *Figure II* shows the workings in both seams where this occurred.

On another property where two mines are operating simultaneously on two seams, each mine owned by a separate company, the workings are so laid out that the upper seam will be completely mined out in a given section of the mine

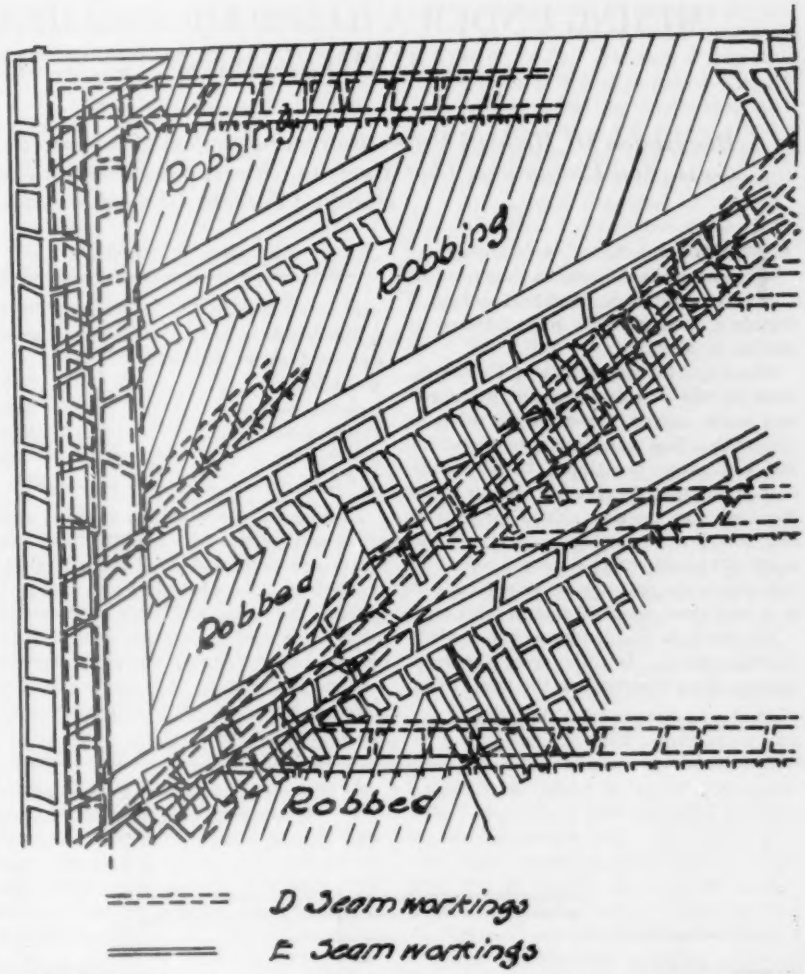

Fig. 3.—Showing D seam advancing while rooms are worked and pillars robbed in E seam

before any rooms are worked in the lower seam. After the upper seam is completely mined the rooms in the lower seam are driven and the pillars robbed. The headings in the lower seam are driven at the same time that the mining is being done in the upper one. This has been the practice for several years, and to date has not given any serious trouble. In a number of instances the coal in the lower seam was sufficiently crushed to cause it to fall off the ribs. The roof was broken enough to require timbering, and some bottom heaving was noticed. This is attributed to obstruction from a cave in the upper seam. The condition exists where it is known that small blocks of coal have been left in the upper seam. The trouble in any one of the cases extends over a small area.

From the experiences noted above and from many other specific cases, it is concluded that two seams of coal with a small interval between them can be economically mined simultaneously if the workings in each seam are arranged with due regard for the other. The entries and rooms of each seam can be worked at the same time, but the pillars can not be robbed in the lower seam until the pillars in the upper seam are mined out, and given time in which to settle.

Great care must be exercised in robbing the upper seam. It is important that the robbing be thoroughly done. Anything which might prevent a good cave, such as gob packs, cribs, or blocks of coal, should be removed. Anything which might prevent a thorough cave will invariably cause a pressure on the lower seam, which will be a continuous source of trouble. This is especially true when the entries and rooms in the lower seam have been worked.

It is almost unreasonable to expect the robbing to be done thoroughly and other obstructions to caves removed in all cases. Therefore we have adopted the plan shown in *Figure III*. In this plan the mining in the upper seam is done in advance of that of the lower seam, entries alone being worked directly under the mining in the upper seam. After the robbing is completed in the upper seam, and time has been allowed for settlement, the rooms in the lower seam can be worked and the pillars robbed without difficulty.

MINING UNDER A BAD ROOF AND HEAVING BOTTOM AT SUGARITE MINE, NEW MEXICO

Description Of Methods Used—Retreating System Advantageous In Spite Of Heavy Timbering Costs, And Precautions That Must Be Observed Because Of Treacherous Roof—Practically One Hundred Percent Of Coal Recovered

By JAMES R. BARBER *

THE Sugarite mine is one of six coal mine operations conducted by the St. Louis, Rocky Mountain & Pacific Company, with headquarters at Raton, N. Mex.

The Sugarite camp and tipple are situated at the bottom of a narrow north and south canyon, the drainage being to the south. The coal seam outcrops about 200 feet above the tipple, to which the coal is brought by gravity planes from No. 1 mine on the west side of the canyon and No. 2 mine on the east side. The walls of the canyon rise steeply some 700 feet above the coal seam and are capped by a lava sheet about 80 feet in thickness.

The work in No. 1 mine is the subject of this paper. In this mine the coal pitches about 2 percent to the west. The coal is from 5 to 5½ feet thick. It is a high grade domestic fuel, with an average analysis as follows:

Moisture	2%
Volatile matter	39%
Fixed carbon	50%
Ash	9%
B. t. u.'s	13,500

Although no fire damp is found in this mine, neither matches, smoking, nor open lights are permitted. All main haulage is electric. No explosives are used in mining the coal, and only permissible grades are used in blasting rock. Main entries are thoroughly limestone dusted.

It is intended in this paper to give some of the history of the operations and the difficulties met.

The mine was opened in 1911 by a main entry and air course driven S. 20° W. in from the outcrop and on the strike of the seam. These entries are protected by a 300-foot barrier pillar on each side and a 50-foot pillar between entry and air course. Cross entries in pairs were driven at right angles to the main entry at 650-foot intervals. Rooms 22 feet wide on 50-foot centers were driven off the cross entries on the advancing system, the pillars to be pulled on the retreat.

A description of the coal bed with the strata above and below will make clear the severe conditions to be met. The coal seam is nearly clean, except for a 1-inch band of bone about 5 inches from the top. This bone and 5-inch layer of coal is left up in the rooms to prevent the slacking of the roof. The roof is com-

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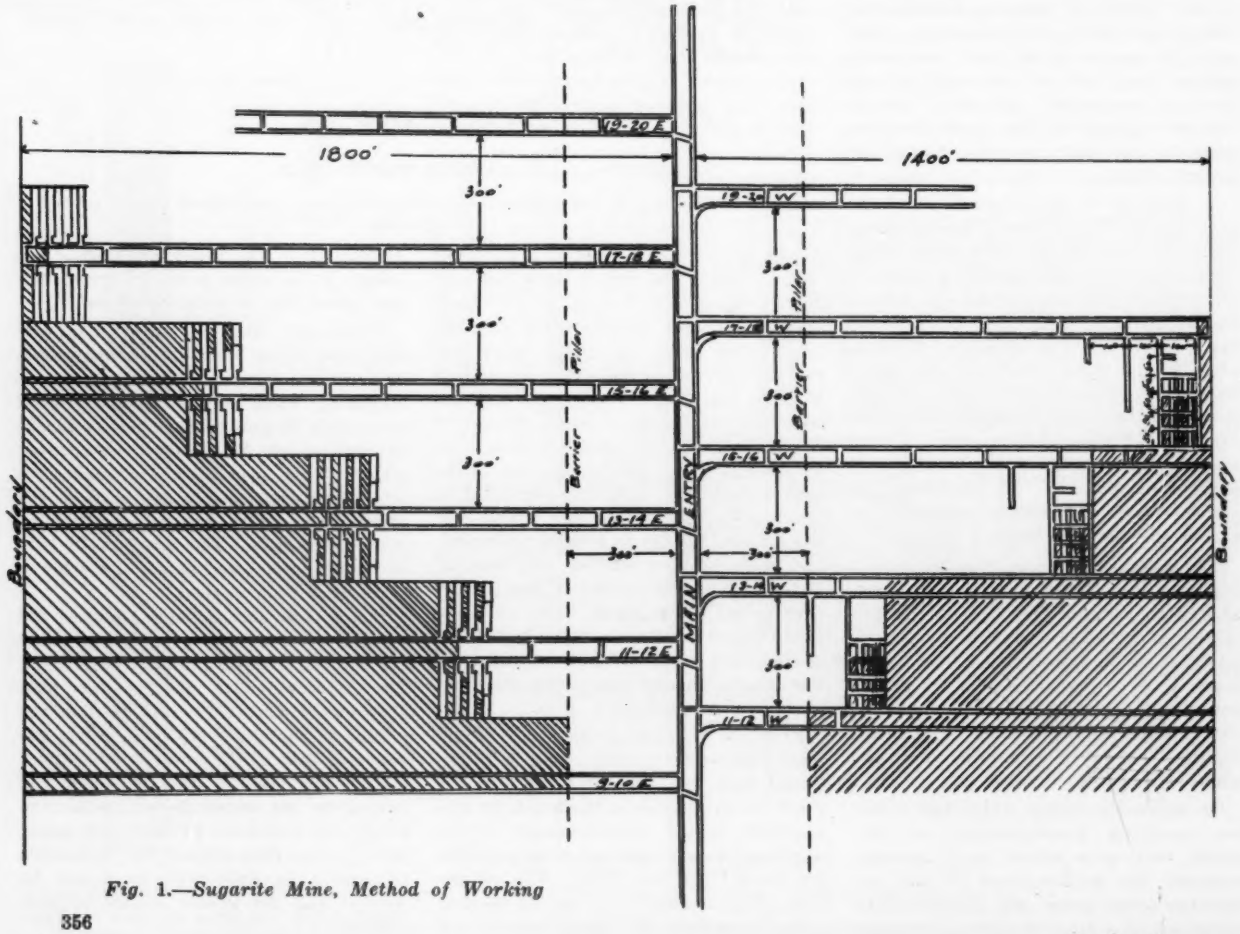


Fig. 1.—Sugarite Mine, Method of Working

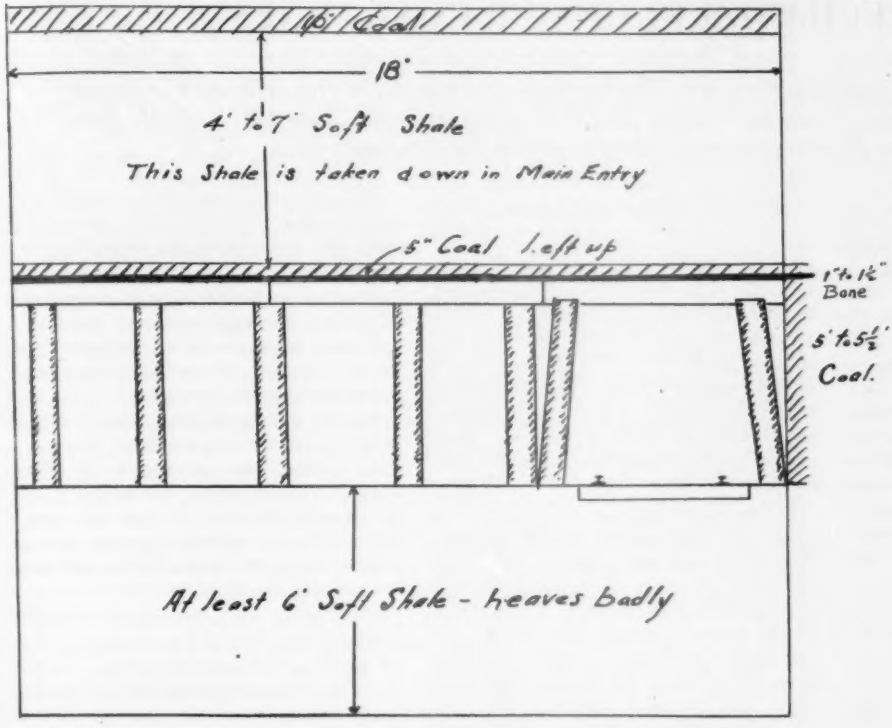


Fig. 2.—Cross section of room, Sugarite Mine. Sets spaced three foot centers

posed of from 4 to 7 feet of friable shale interspersed at times with two thin seams of coal. Above this shale mixture is a 10-inch seam of coal which is the first firm strata above the main coal; then more soft shale above. The bottom for a depth of 6 feet is shale, the upper 10 inches of which is exceedingly soft.

To add to the difficulties of such a roof and bottom, the mine produces a small amount of water. This water, if not caught in sumps and pumped out immediately, causes the bottom to become boggy and heave badly.

The face cleats of the coal seam are well defined at right angles to the strike. When weight comes on the coal it slabs off in blocks from 3 to 8 inches in thickness.

Referring again to the first system of mining tried, with rooms 50 feet apart, to be driven 300 feet and pillars brought back, at the outset it was realized that unusual precautions must be taken to prevent extended squeezing. After six rooms were turned, a block of coal 100 feet wide was left before turning the seventh room. This, it was thought, would localize a squeeze if one started.

With this system, no serious difficulties were encountered while mining near the outcrop. The roof gave little trouble and heaving of the bottom was not serious except where considerable water was trapped. However, as the main and cross entries advanced and gained cover the timbering costs became excessive. A good many rooms were lost before they reached their prescribed length or before much of the pillar was recovered. Certain areas where considerable coal had been removed squeezed and heaved so badly that roof and bottom met. In places where the pillars alone remained and the rooms were very thoroughly timbered a very great side pressure developed in this soft shale above the coal. The crossbars showed great distress, bending and in some cases jack-knifing. This side pressure was so great as to cause a folding of these shales, which could be seen plainly at points just beyond a caved section. A photograph of one of these folds is shown in *Figure III*, which, while not a good photograph, may give an idea of this unusual condition.

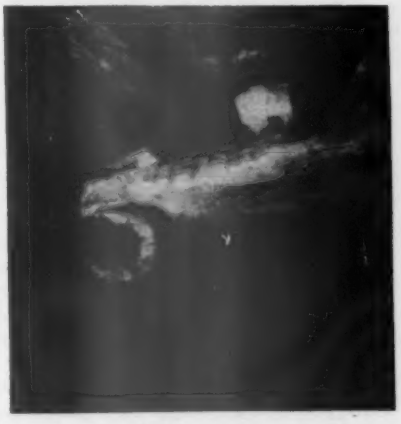


FIG. 3

At this time we were trying to hold the roof in the rooms by using 16-foot crossbars 3 feet on centers in a 20-foot room. These were supported by four props, one on each side of the roadway and two toward the gob side. This left 4 feet beyond the crossbar, and a plan was tried of cutting a slot up through the shale roof to the 10-inch coal seam in this 4-foot space. The idea was that this would relieve the side pressure. The side pressure was relieved, but in doing so it crowded the crossbar and props toward the gob side so much that the pit car could not pass.

At this time a somewhat different method of mining was being tried. In an inside pair of west entries which had reached the boundary, six 7-foot wide places had been driven to the right and six to the left, 50 feet on center. These were top brushed for height and timbered by sets 3 feet apart. These six places on each side were driven 300 feet and connected by breakthroughs at the faces. No. 1 room (the lowest place to the dip) was started back, taking 25 feet of pillar each side. After No. 1 had retreated 25 feet, No. 2 was started back. Successive pillars were started pulling back so that each was 25 feet back of the adjoining pillar. The above method of mining has merits which can not be discussed here.

About this time the brushing and timbering costs were becoming so excessive that it was realized a drastic change must be made. After a thorough study by company men, advised by expert outside assistance, the present method of mining by retreat was adopted.

In planning this retreating system, the fact that the east entries had less cover and consequently the conditions would be less severe was considered. Also, these east entries are to the raise and water can be more readily handled. Therefore, two somewhat different methods have been used.

The east entries are turned 300 feet between pairs and driven 1,800 feet to an arbitrary boundary. No rooms are turned until the pair of entries are completed. These entries are timbered throughout with spruce sets 3 feet on centers. Twenty feet back from the face the first room is turned off each cross entry, followed by two more rooms in each entry. These three rooms are driven up 150 feet and the pillars drawn back immediately and almost completed before the next three rooms are turned. This cycle of operations is continued until the 1,500 feet of coal is worked out back to the 300-foot (*continued on page* 365)

THE MECHANIZING OF OUR COAL MINES*

After Careful Study Of Industry Coal Men Are Of Opinion That Major Opportunity For Saving Lies In Mechanizing Mines—Cutting, Mining And Conveying At Same Time With One Machine An Idea Receiving Careful Consideration By Operating Men

By NIXON W. ELMER†

IN EVERY industry there is a strong inclination and natural tendency to do things in the same way that every one else in the same industry is doing them, concentrating our efforts on doing them a little bit better than the other fellow. No general change of methods takes place in any industry in a brief space of time, except under the spur of necessity, usually furnished by bitter competition.

I think that you will agree with me that such necessitous conditions exist in the bituminous coal mining industry today. Reacting to this universal stimulant, necessity, the coal mining industry has gone over its standardized practice and customary sequence of operations, with an open mind and a searching eye.

After repeated study of operations and cost data, man after man in widely separated districts, has apparently come to the same conclusion, namely that the opportunity for a major saving lies in one place only. This is at the face and as far back as the haulage entry.

Here is located the major part of the labor item of mine coal cost. Much of this is hand labor, in fact it is safe to say that more than 95 percent of all the coal used by the industries today has been man-handled about as follows: Dug out of the side of a pile in semi darkness with a shovel, carried an average of one step on the shovel and lifted higher than the miner's shoulders and placed in a car, which car is not in place to receive this coal more than 75 percent of the time.

Of course the miner does not need to shovel coal eight hours, but the two hours he loses are, generally speaking, during the time when he must shovel coal because the face is not ready to work on till the free coal is cleaned up. This means that he either wastes this time or uses it uneconomically in moving the more distant coal closer to the place where the car will be, thus handling this part of the coal twice.

A commonly expressed, though perhaps not a very thoughtful view-point, has been that the miners generally work on a tonnage basis and will demand and receive double wages if their output is doubled by mechanical means at the expense of the operator. The corollary of this thought being that the individual miner won't work but half the time, in this case. The point missed here is that, with group machinery, there is no longer any possibility of individual tonnage payment, the very machinery itself will force tonnage work to be of the group type, and with group work an average number of absentees can always be allowed for and taken care of, without affecting scheduled production.

Furthermore, in setting such new group tonnage rates it is not probable that these new rates will be such that the miner who had formerly made $10 per day, would be raised to $20 per day for the same time and easier work. As a matter of fact most of such work now going on, is being done on a day rate basis, and the men like the idea and take to it both because the work itself is easier and because of the element of social intercourse thus introduced into lives notably barren in this respect. The logical development here would seem to be in the direction of day labor with a group bonus for group tonnage production.

The factor just spoken of, namely the social element introduced into the miners' lives in this way, is an intangible, which seems an airy nothing to the man in a busy office seeking privacy; but to the miner underground it seems to be of real importance. When we stop to think, this is understandable. Men always prefer to do manual labor in gangs rather than individually, or in pairs. Those of us who have passed through a stage of being paid for muscle alone, should be able to remember this.

Many an otherwise thoroughly competent engineer or executive has failed to make a success of a carefully worked out and mechanically correct project, through neglect of such human preferences, the likes and the dislikes of the man behind the shovel.

While I, for one, can not claim to have foreseen this result, and more time will have to pass before it can be said to be proved generally, still it is very interesting to note that, even with no increase of wages, these better, easier and more social conditions are attracting a higher grade of more intelligent labor underground. This is certainly important and will mean a lot to the industry, if general experience parallels individual experience in this respect.

To get back to the general subject of mechanizing the hand labor operations from the face, let us ask ourselves two questions:

First, what is the order of magnitude of the possible savings at this point?

Second, what means are in sight that appear as possible or probable means for achieving such saving?

Taking up the first question: What is the order of magnitude of the possible savings over present hand labor methods from the face, out to the haulage entry? Please note that this question deals solely with the *possible saving* in *hand labor*, without defining the particular mechanical method to be used.

While there are larger figures on good authority, the figures I am going to give are based on personal experience. I do not believe, however, that the use of this or that particular method or means should affect these results materially, *provided* the method selected *fits* the *conditions* in the *particular mine*. This is a new thought to many and deserves to be emphasized. There is not and never has been one best method of handling bulk materials mechanically. Success follows a wise selection of mechanical means, where the machine and the method are respectively so modified and coordinated that they work together to the best advantage under the special conditions in the particular mine.

Where a certain group of workmen average 10 tons per eight hours, doing their own track laying at the face and their own drilling and shooting, under a suitable and carefully worked out mechanizing system, these same men can and do handle from 20 to 30 tons per eight hour shift, depending upon how much shooting, drilling and moving of equipment they are required to do. The *actual tons quoted* are *not* significant, it is the proportional increase obtained that has a real meaning for us. The methods used for mechanical handling to which these figures apply, were mostly chain conveyors. I have seen, and others here can tell you of, similar results with belt and apron conveyors. In such cases, shovels, man handled, are used as of old, merely the conditions under which the shovellers work, are changed.

Under other mining conditions, cable drags have successfully replaced the shovellers entirely with equal or better results, and where lumps are not large belts will undoubtedly find their place

* Paper presented to Amer. Soc. of Mech. Engineers, New York City, March 11.

† Quincy, Mass.

in the future. Circumstances frequently call for a combination of two or more of these methods, but the results to date fall within the limits mentioned of two to three times the normal room and pillar output of the same individual.

The mining methods used in these various applications, run the whole gamut from straight room and pillar, through modified room and pillar, modified long wall to long wall. It does not require a prophet to see that some of these applications, useful as they are in themselves, are merely half-way stations furnishing the necessary background for a still more substantial success with loading machines. It has seemed to me sometimes that the cart frequently preceded the horse in much of our experimenting with loading machines. A suction dredge without a discharge pipe would be analogous to a loading maching without anything to load into. Like most machinery, loading machines can earn no dividends when they are idle.

We are now ready to attempt the answer to our first question: What is the order of magnitude of the possible savings, through mechanizing the operations from the face to the haulage entry? On the face of the results quoted, this would appear to be not less than 50 percent of the direct labor. Please note, however, that we are speaking of the possible saving. The actual saving to date usually has been less than 50 percent of the direct labor, particularly at the start. This is not surprising, because the mechanical details of the various types of equipment have not had time to go through the normal cycle of improvement and the operating forces have not had time to develop the technique of operation.

Under almost every conceivable mechanizing scheme, the unit becomes a group instead of one, or, at the most, two individuals. This means that one consequence of the complete mechanizing of any mine must be to greatly reduce the area worked for a given production. Concentration of working areas of the order of magnitude of 10 to 1 are to be expected. On paper your mine foreman can show from this a saving of general underground overhead labor of from 20 to 25 percent, but this saving will not appear on the cost sheets till the whole mine is mechanized, the idle parts closed, and the unnecessary portion of the overhead labor pried loose from its hereditary jobs and absorbed in the productive labor. This takes time. It took the Government five years to reduce their Departmental organizations in Washington after the war! When this reduction has been accomplished, this item of savings in overhead labor should fully balance the extra men used to handle and operate the machinery employed in the mechanizing. Then, the *possible* saving will become the *actual* saving. At first we will have to be satisfied with about half the possible saving.

We now come to our second question: What means are in sight that appear as possible or probable ways for achieving such savings?

In some of the early efforts, the assumption was made that the mining system would have to be altered radically to fit the mechanizing means. In the light of present experience this seems to have been unnecessary, because the available means for mechanizing are so numerous and various that suitable ones can be and have been adapted to almost every type and method of mining. On the other hand, it is often more economical in the individual case, to change the mining system, where this is allowable. There are two main reasons for not changing a mining system, where money will be definitely saved by doing so: One is the safety of the workmen and property, and the other is mental inflexibility on the part of the management; of course either may function separately or both together. Where the mining system can not be changed, it is reasonably certain that some form of mechanizing can be adapted and modified to fit existing conditions.

It is well to bear in mind that equipment already developed above ground should form the *basis* for the development of similar underground equipment; but that the mere transplanting of such equipment bodily, without suitable modification, will always prove unsatisfactory. In making such modifications to fit underground conditions, full advantage should be taken of the years of experience gained above ground with similar coal handling equipment. This is where the material handling section of the A. S. M. E. may individually or collectively be made of use to the mining fraternity. The two or three statements about the use of above-ground experience, below-ground, sound so self-evident that they hardly seem worth saying, but they certainly need to be taken to heart because the facts are that our general practice seems to have been almost the exact opposite. That is to say, we have *not* generally made use of above-ground coal handling experience under-ground, and we *have attempted* to *transplant* developed above-ground equipment bodily into our mines. In these two mistakes may be found the reason for many of our failures.

I have digressed a little. The question before us is: What means are in sight which are capable of achieving important savings near the face? As this is to be a verbal, nor a visual, table, I will simplify it by restricting myself to conveying methods, and *assume*, for the reasons already stated, that the loading machine should follow rather than precede the conveyors. The more promising of the efforts with which I am acquainted, may be grouped as follows:

LONG WALL:
- Cable scraper or hoe.
- Chain conveyors.
- Apron conveyors.
- Combined mining and conveying.
- Jigging conveyors.

MODIFIED LONG WALL:

SAW TOOTH OR Y—
- Apron conveyor.
- Chain conveyor.
- Cable scraper or hoe.
- One or more of these combined with belts.
- Jigging conveyors.

V TYPE—
- Apron conveyors.

ROOM AND PILLAR:
- Cable scraper or hoe.
- Chain conveyors.
- A combination of either or both of these with belts.
- Belt conveyors alone.

Each of these conveyor types has its strong and weak points. Salesmen will present the former, but unless we familiarize ourselves with the inherent weaknesses of each type, we can not hope to select and adapt wisely, except by some more or less fortunate accident.

The logical line of development of the heavier type of apron conveyor will be to so improve it that it can come closer and closer to the face to be shot. This leaves little opportunity for the use of loading machines. On the other hand, the next and obvious step with most of the other types of conveyor (except the cable scraper) is to adapt a suitable loading device to caterpillar traction and develop a successful continuous feed therefrom to the conveyor and thus eliminate most of the hand shovel labor, already materially reduced by the conveyor. This you will notice assumes that the loader is introduced into the scheme *after* the conveyor application has been fully worked out, has paid its way and reached a state of reasonable working perfection. It does not pay to attempt to introduce two separate but interdependent improvements at once. The reason that the conveyor should precede the loading device is that the conveyor installation will pay its way as it goes, and nothing will have to be undone when the loaders are later introduced. Also the cleaning problem is postponed.

Below ground as well as above, there is no one best type of conveyor, some types have received more attention than others and their underground development had proceeded farther, but each has its own strong points and weaknesses which must eventually determine its individual field of usefulness. It is inevitable that in many cases the best results will (*Continued on page* 365)

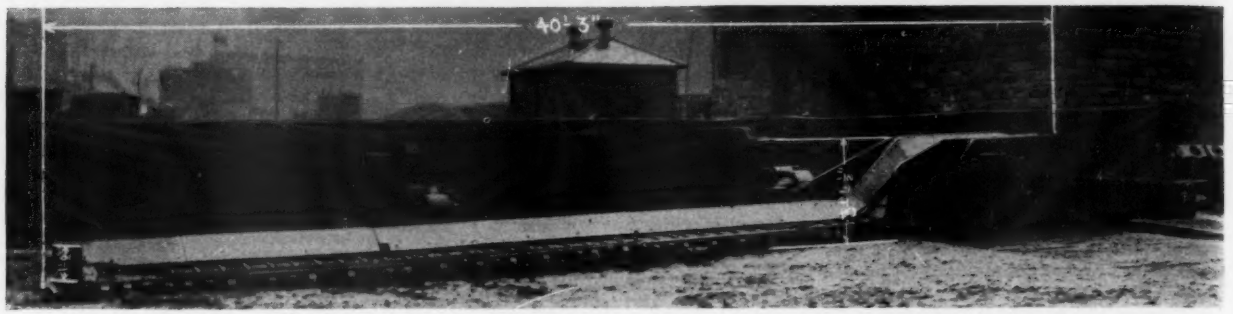


Fig. 1.—Front view of the O'Toole Cutting and Loading Machine with the roof control machines in place

AN EXPERIMENT IN COMBINED CUTTING, MINING AND LOADING IN COAL MINES*

Introduction Of Cutting And Loading Machines Should Bring About: Reduction Manual Labor; Increased Production Per Man; Better Transportation And Ventilation; Reduction In Timber And Drainage Costs; Increased Percentage Domestic Sizes And Reduction In Hazards

By COL. EDWARD O'TOOLE†

THE mining of coal must increase if the prosperity of the country is to increase, for the reason that oil and natural gas, which have been until recently produced in quantities largely in excess of demand in the United States, are now on the decline, and will soon be withdrawn from the power production field; and the possible production of power from hydro-electrical plants in the commercial centers of the country has been largely overestimated.

Therefore the greatly increasing demand for power must be supplied by coal, and particularly by bituminous coal. Some means of lightening the labor of our miners and increasing the production of coal from our available labor supply must be found. Machinery must be more generally applied to coal mining. At present, machinery is applied quite generally to coal handling outside of the mines, but only to a very limited extent inside the mines.

In the mining of coal we are still in the old hand shovel and hand pick stage. The coal seams of the United States, particularly the seams of bituminous coal, lie in horizontal blanket beds in the stratafied rocks of the earth at varying distances below the surface. From these seams, or beds, we mine approximately 525,000,000 tons of coal annually.

The object to be attained in mining is to break the seam of coal up so that it can be handled, and get it into a mine car, conveyor or vehicle of some kind, so it can be moved to the point of consumption.

The United States Coal & Coke Co. is a subsidiary of the United States Steel Corporation, and mines coal exclusively for by-product coke ovens operated by the constituent companies of the corporation. They have mines at Gary, W. Va., and Lynch, Ky. At its mines this company had been conducting experiments with a type machine which undercuts the coal seam in such a manner as to permit the weight of the over-lying strata to be thrown on the undercut coal, which extra weight breaks the coal loose from the seam without the use of explosives. The coal broken loose, in falling, lands on a conveyor which is in motion and which conveys it to and loads it into the mine cars.

To successfully break the coal loose from the seam by roof pressure, it is necessary to have the roof under control.

Roof control is the most difficult operation in mining, and for the successful operation of this machine it is necessary to have complete roof control. Roof control means the holding of the roof of the mine up during the process of mining, and letting it come down when there is no further necessity for holding it up. The proper control of the roof in any method of mining is one of the most difficult, dangerous and expensive items of work connected with mining.

It is difficult because the roof varies in composition and texture. It is dangerous because at times it gets beyond control and falls without warning and injures the workmen. It is expensive because when it gets beyond control, it comes down before the mining of the coal is completed, and has to be moved, or the covered coal is lost, which adds to the expense. An additional expense is the cost of timber, or other supports used for its control, and the labor cost of placing and removing timber and supports.

EXPLANATION OF THE ROOF PROBLEM

The strata overlying coal seams generally weighs about 160 pounds per cubic foot. Therefore, with a cover 100 feet thick, the load on each square foot of the coal seam would be 160 times 100, or 16,000 pounds, or 8 tons. This load would be increased directly in proportion to the percentage of the coal which was removed in the first workings. If 50 percent of the coal is being extracted in the first workings, this load will be doubled, which will give an average load of 16 tons per square foot, which is about the safe load for red brick in the wall of a building.

Safe Load Per Square Inch Allowed On Brick Work

Common:	Lbs.
Portland cement mortar	175
Good lime and cement mortar..	125
Good lime mortar	100

(Stresses allowed on brick work taken from Chicago Building Ordnance and given in Hood & Johnson Handbook of Building Construction, Vol. I, p. 11.)

In mining, the weight on the pillars left to support the roof becomes greater as mining progresses. The pressure per square foot on that portion of the coal seam adjacent to the open area will vary in proportion:

1. As to the thickness of cover.

* Paper presented at meeting held under auspices of American Society of Mechanical Engineers and National Coal Association, New York City, March 11.

† General Manager, U. S. Coal & Coke Co., Gary, W. Va.

2. As to the strength of overlying strata.

3. With distance between the pillars, as the pressure is carried from pillar to pillar, just as the pressure on the abutments of a bridge is carried from abutment to abutment, and becomes greater as the length of the span or distance between the abutments becomes longer.

The pillars are to the overlying strata or roof of the coal mine as the abutments or piers are to a bridge, and the layers of the overlying strata are to mine roof as the girders of a bridge. They carry the weight from pillar to pillar over the excavated portion of the mine as the girders of a bridge carry the weight and load of the bridge over the unsupported space between the abutments of the bridge.

The stratafication overlying coal seams varies greatly in strength in different localities. At places there are layers of massive sandstone 200 feet thick overlying the coal seam, which requires a large area of the coal seam to be extracted before its own weight and the weight above it will break it down. In such cases the space between the mine pillars may have to be extended until it is three times as far from pillar to pillar as the thickness of the strongest band of rock in the overlying strata.

For example: If the strongest band of strata overlying the coal was 200 feet thick, the workings in the seam would have to be excavated about 600 feet in width before it would break, and if such was the case, and the cover was 300 feet thick, the rupturing load on the coal pillars adjacent and surrounding the excavation would be as follows:

160 (weight of strata per cu. foot), times 300 (thickness of cover), times 300 (one-half the distance from pillars), divided by 2,000 lbs. (1 ton), equals 7,200 tons per square foot, less the weight of the more friable portion of the strata between the coal seam and predominating or load-carrying band of the overlying strata, which would have fallen to the height of the load carrying band as the excavation of the opening in the seam progressed.

When the girders of a bridge come to the rupturing point, the girder ruptures or breaks at, or about the center, the ends bearing on the abutments raising in the air, and drawing toward the center, to let the center go down; but in the rupturing of the roof of a coal mine, when the load on the band of strata, which is carrying the weight to the pillars becomes too great and reaches its rupturing point, it can not move toward the center as a bridge girder does, as it is held fast in place at both ends by the overlying strata on the unexcavated portion of the seam; and as it must fracture when the stress becomes too great for its strength, the moment the load on the center produces a deflection at or near the edge of the pillar, it comes down, and the pressure on the pillars adjacent is then reduced to about its regular pressure.

Just before the strata breaks is the critical moment in roof control. Thereafter the pressure will be approximately that due to the thickness in feet of the overburden, and would be reduced to exactly the weight of the overburden if it was not for the reason that the strata will not shear vertically, but generally about 15 degrees from the vertical, and overhanging the open area.

It is under this overhang of the pillar that the machine works, and it is the pressure due to this overhang that brings down the coal, at times fracturing it even before it is undercut, so that it falls ahead of the cutters, and the only work the cutters have to do is to square up the bottom.

Roof control more or less affects all the branches of mining. If you can control the roof, you can take out all the pillars on their turn, and reduce the open workings of the mine to a minimum, which will reduce the territory to be ventilated and drained, timbered, et cetera. All the coal in the seam can be extracted, and this complete extraction can be accomplished with very slight damage to the surface, as the surface would be let down more evenly with fewer fractures.

Explanation of Mine Dangers

All mines have danger zones. In some mines the danger zone is larger and more acute than in others. Some mines have a danger zone at the working face in the solid coal, caused by explosive gas being liberated as the mining progresses. Some mines have a danger zone in the second mining, or pillar drawing stage, caused by explosive gas being liberated from the strata overlying the coal, which is liberated when the strata is broken. This explosive gas, being lighter than air, accumulates in the high places, such as the cavities and crevices, caused by breaks in the strata or falls of the mine roof, and, if in sufficient quantities, the adjacent open workings.

Some mines have danger zones, due to large open spaces left in the mine, due to the non-extraction of pillars, and such open spaces, when not properly ventilated, become the same as a backwater of a stream. In such open areas the very fine coal dust that is carried in the mine air settles on the sides, timbering, and floor, just as mud from the water settles in backwater sections, which dust will be raised in the mine atmosphere at every inrush of air caused by the passing of the haulage motor, falls of roof, small gas or powder explosions, etc. In all mines there are dangers from falls of material either from the sides or roof of all places in the mine. In our mines we draw a line horizontally along the sides of all hauling, traveling and air ways, and along the face of each working place, 3 feet from the bottom, and consider all space above this line as a danger zone.

The mining law of most all mining states requires the removal of danger from all abandoned or temporarily abandoned open spaces in the mine. This should mean that they must be properly ventilated. This brings up the question:

What Is Proper Ventilation?

According to Allen and Walker's book on "Heating and Ventilation," page 181, table 39, all the air in public waiting rooms should be renewed four times per hour; public toilet rooms, 10 times per hour; small convention halls, 4 times per hour; general officers, three times per hour; public dining rooms, four times per hour; banquet halls, five times per hour; hotel kitchens, four to six times per hour; textile mills, four times per hour.

Do open spaces in mines require as much or more ventilation than these classes of buildings? If so, this open space in mines becomes a very serious matter. For example:

The open space in a mine producing 3,500 tons of coal per day is as follows:

	Length in feet.	Cubic feet of open workings.
Headings	101,700	6,857,6[illegible]
Air course	94,800	9,297,984
Breakthrus	49,285	4,229,638
Rooms	28,300	4,163,496
Machine room	8,900	1,091,140
Breakthrus	11,280	968,049
Drainage heading	14,800	1,814,4[illegible]
Total number cu. ft. open work...		28,422,418

As this mine has a capacity of 3,500 tons of coal per day the above equals about 8,000 cu. feet open space in this mine for each ton of daily capacity. Eight thousand cu. feet per ton of daily capacity is possibly the minimum amount of mine space any mine operated on the room and pillar system with the type of mining machinery now in general use should have. The average for the country would be about 20,000 cu. feet of mine space per ton of daily capacity.

If this mine was ventilated as well as general office buildings, it would necessitate the circulating of 576,000 cu. feet of air through it each 24 hours, per ton of coal produced.

If this mine was ventilated as well as convention halls, it would need 760,000 cu. feet of air each 24 hours per ton produced.

If it was ventilated as well as banquet halls, it would need 960,000 cu. feet per 24 hours, per ton produced.

Some large mines produce as much as 10,000 tons of coal per day. One ton of

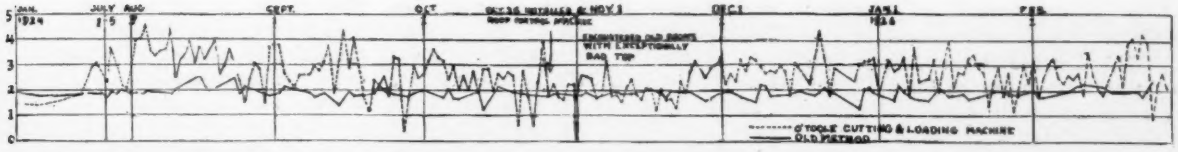


Chart showing comparison of tons loaded per man-hour by the O'Toole Cutting and Loading Machine and the old method

coal in the solid seam occupies about 25 cu. feet of space, therefore each day's mining produces 10,000 times 25, which is 250,000 cu. feet of open space, plus the cu. feet of rock and refuse that is removed.

Allowing 200 days for a year, at the end of the first year there will be 50,000,000 cu. feet of open space in such a mine, and if in 10 years no pillars are drawn, and open spaces are not filled by water or other means, there will be 500,000,000 cu. feet of open space in such a mine.

I have developed this subject of mine ventilation for the purpose of showing you the magnitude of the problem of properly ventilating large mines by replacing all the air from their vast spaces three, four, or five times per hour, as required in office buildings, assembly rooms, or banquet halls.

Two shafts were sunk at Gary, W. Va., 600 feet to a coal seam by the U. S. Coal and Coke Co., in June, 1915. Since that time the mine has been developed, and 1,710,257 tons of coal mined and shipped, and, in addition, this mine has hoisted and stored on the mountain side a great amount of rock and refuse. Therefore the space evacuated in the mine is approximately 45,000,000 cu. feet.

As they have drawn no pillars to cave the rock, or filled the space from which they mined the coal and rock, this excavated space is standing full of air. To ventilate this mine there is 200,000 cu. feet of air per minute going in one of these shafts and about the same amount coming out the other. The chemical analysis of the exhausted air shows that it contains .9 of 1 percent of explosive gas (carbureted hydrogen—CH_4).

This CH_4 transpires from the coal surrounding the spaces from which the coal shipped was mined. When it first issues from the coal it is pure, but when it comes in contact with the mine air it diffuses and mixes with the mine air and pollutes it to the extent that all the air coming from the mine contains .9 of 1 percent of CH_4.

During the diffusion period, it has passed through all percentages of mixtures of gas and air, from the pure carbureted hydrogen to the mixture of carbureted hydrogen and air which is exhausted from the mine.

Carbureted hydrogen, when pure, is non-explosive, but when mixed with air it becomes violently explosive.

This mine produces about 2,500,000 cu. feet of pure CH_4 per 24 hours, and at all times there are about 400,000 cu. feet of pure carbureted hydrogen, mixed with the mine air occupying the spaces in the mine. This mine has about 130 working places, is equipped with the usual mining machines, and produces about 2,000 tons of coal per 24 hours, averaging about 15 tons of coal per working place per 24 hours.

This mine uses about 700 pounds of explosives per 24 hours to break down the coal and rock. The mine is only receiving one-tenth the air required to properly ventilate general office buildings, and for the want of more air is dangerous. It is possible to increase the air entering this mine about 50 percent, but only at a great expense, as the velocity of the air current in the shafts is now 1,500 feet per minute, and the power required to produce more air will increase as the cube of the velocity. Therefore to secure 50 percent more air will require over three times the power. To get general office air requirements into the mine would require 1,000 times the present power.

To safely increase the production from this mine operations can be concentrated, so that the production from each working place will be from 300 to 400 tons per working place per day, instead of 15 tons per working place, as at present. The ventilation will then be a small problem, and the mine will be made safe for the workmen.

The benefits received by the introduction of the cutting and loading machine are as follows:

(1) Increase the amount of coal coming from a given amount of space or open territory by the concentration of operation, intensified operation in a smaller territory by the larger application of mechanical power than is possible by the present method of applying mechanical power and hand labor combined.

(2) A reduction of manual labor necessary to produce a ton of coal.

(3) Increase the amount of coal produced per man per hour by the coal getter or the man who works at the face, getting the coal.

(4) The increasing of the amount of coal transported per man-hour by the men engaged in the Transportation Department of the coal mine by substituting conveyors for present methods.

(5) The reduction of the amount of ventilation required in a coal mine on account of the reduced open spaces in the mine.

(6) Reduction of amount of timbering by reduction of open spaces requiring timber.

(7) Reduction in the amount of drainage for same reason as given above.

(8) Increase the number of tons produced per ton of timber and other materials and supplies used.

(9) The increase in the percentage of the large or domestic sizes of coal—about 15 percent—due to the absence of the pulverizing effect of the explosives, and the consequent reduction in the amount of the smaller or fine sizes of coal, which are of less commercial value.

(10) Reduction of the hazard in coal mining, both as to catastrophies (generally due to explosions, which have always occurred with varying frequency, and kill men in large numbers in the twinkling of an eye), as well as a reduction of hazards to the individual miner, as it will be possible to keep the men operating the machine under closer supervision in a place that can be well lighted.

We have experimented with the machine as a cutting and loading machine performing these two functions of mining at the same time; also undercutting with it separately and loading with it separately. Strange to say, it requires less power to operate the machine when cutting and loading than when loading only. As it is primarily a cutting and loading machine, we operate it as a cutting and loading machine.

We have worked it on ribs and stumps and slabs. Where we have operated this machine the seam is about 7 feet thick and lies flat, but we believe that the machine can be operated to mine all the coal in any seam from 2½ to 12 feet thick, and where the seams lie at all angles of inclination, from horizontal to vertical.

We also believe it applicable to the mining of all kinds of coal—antharcite, bituminous or lignite—and that it can be made applicable to the mining of the soft iron ores of Michigan and Minnesota, or the oil shales of Colorado.

The first experimental machine was put to work on the 30th of November, 1923, and it has been working continuously up to the present time, and is still working.

The total possible hours, since the ma-

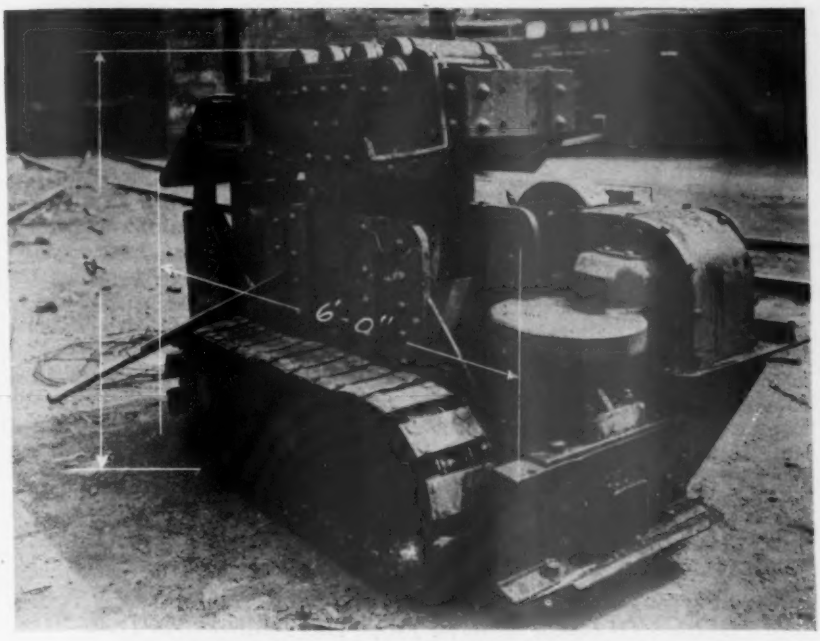


Fig. 2.—Second type of roof control machine, built like a tractor or army tank

chine was installed, is 15,147. The machine has been in operation and was either cutting and loading coal, undergoing repairs, or being moved from one place to another, being stopped on account of roof conditions, or from various other causes. The percentage of time of operation of each item is as follows:

Delays from Dec. 1, 1923, to Feb. 28, 1826		
Cause of Delay	Hours lost	Percentage to total time lost
Electrical equipment failures.	726	7.3863%
Mechanical failures	1,679	17.0821%
Roof control	4,077	41.4793%
Miscellaneous (delays in other departments over which machine crew has no control).	3,347	34.0523%
Total	9,829	100.0000%

You will note that 24.4 percent of the delays were due to electrical and mechanical failures, which is not unusual in an experimental machine. However, you will note that the principal cause of delay with this machine has been on account of the roof, the moving and resetting of timbers. This gave considerable trouble at first, and it was thought by many to be an insurmountable difficulty, but has resulted in the development of a roof control machine.

This concentration of the operation renders it possible to mechanically control the roof by use of "Roof Control Machines," which will reduce the amount of timber and the necessity for it, and also the labor now required to put the timber used in place.

The cutting and loading machine itself is built up of structural steel, principally plates, bars and angles. It is built in variable length sections up to 20 feet in length. Our present machine is only 50 feet in length, but we believe it can be successfully operated in 100-foot lengths or to any length at which it is possible to operate a drag conveyor. The chain that cuts the coal travels horizontally around the frame. The chains and bars that form the drag conveyor travel around the frame vertically.

The chart shows graphically the operation of the machine in tons of coal produced per man-hour since it was first put into operation as compared with our old style of operation. The man-hours per ton shown, include all repairs to machine, moving machine, timbering and experimenting with various methods of operations and various roof control machines.

For the month just passed—February, 1926—the men working the machine produced 2.476 tons per man per hour, while the men working by the old method in the same mine, produced 1.88 tons per man per hour. This 1.88 tons per man-hour is very high for the old method of operation. There are very few, if any, other mines in the United States that will reach this production per man-hour. This shows that the efficiency and production of the men per man-hour has been increased .596 tons per hour, or 31.7 percent.

Following are some of the best records made by the machine:

	Tons
Best consecutive one hour.....	63
Best consecutive eight hours.....	318½
Best consecutive 16 hours.....	518
Best consecutive 24 hours.....	672
Best consecutive 48 hours.....	1,274
Best record for one month.....	9,958

Figure 1 shows the No. 3 machine at the Lynch mine shop with roof control machines in place. This machine was built and is in operation at Lynch, Ky. It is built around two old under-cutting machines, for the purpose of demonstrating the possibility of changing our present under-cutting machines into cutting and loading machines.

Attention is called to the vertical shearer on the end opposite the loading end. This vertical cutter is only about 2 feet high, but it can be extended to any height desired. This cutter can be put on or taken off in a very short time, and is designed to shear the tight rib when cutting and loading machine is working on a slab.

The roof control machines are equipped with a five horsepower motor and mechanism which propels themselves and the cutting and loading machine forward. You will notice that there is a 6-inch by 6-inch block resting on top of the rollers on each of these machines and there is a plank 2 inches by 10 inches by 12 feet, mortised to them. When unnecessary, this plank is left off, and only the 6-inch blocks with projecting pieces used. When the roof control machine travels out from under these blocks and plank, and they drop off at the rear of the machine, they are brought forward and again placed on the front. When the 12-foot span, shown in the photograph, is too great to control the roof, another roof control machine is placed between them.

Figure 2 is a larger view of the roof control machine. You will see that it is built like a tractor or Army tank with the exception that it has rollers on the top. Sticking out of the side is the handle of a 200-ton hydraulic jack, around which the machine is built. This jack raises or lowers the top portion of the machine where the variable thickness of the seam makes such adjustment necessary.

As explained in the former view, this tank propels itself and the cutting and loading machine forward, and when in sufficient numbers, will control the mine roof and protect the machine from the possibility of being covered by roof falls.

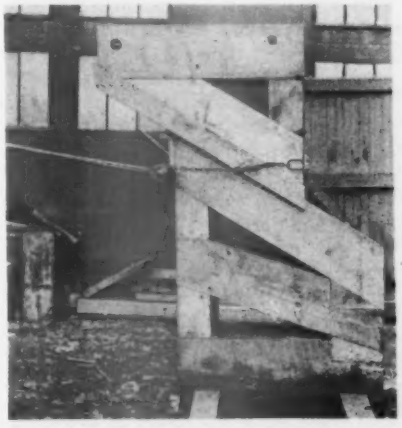


Fig. 3.—Third type of roof control machine, built in the shape of a crib

We believe, by the use of these tanks, we can control any kind of roof overlying any coal seam. We have built these roof control machines in three types; one on which the rollers were placed in the caterpillar chain, the front of the roof control machine sliding on these rollers. The view shown here is the second type.

These two types propel the machine forward into the coal, protecting the roof as the coal is excavated, and permitting the roof to fall and slide off the back of the roof control machine, when there is no further necessity for holding it.

Figure 3 is the third type of roof control machine, and is built in the shape of a crib. It is made collapsible by the top part sliding down over the bottom part. When carrying the load it is held in position as shown by a chain. The proper angle of the sliding parts is the essential feature of this crib.

This crib, as shown, is now being operated by hand, and is smaller than they will be built when operated by a motor, which motor will be placed in the bottom part of this crib. This motor will drive a nut feeding a threaded bar, forward, which bar will push the cutting and loading machine forward.

Each of these types of roof control machines has its special features, and we have not, as yet, adopted a standard type, but we have gone far enough to know that either type is superior to any previous attempt in roof control machines.

In our regular operation it requires one pound of explosive for each 7.3 tons of coal produced, which with the cutting and loading machine method, explosives used equal only one pound per 75 tons of coal, or about 1/10. This means that the hazard from explosives is greatly reduced.

We are now bringing out a new type machine, which will incorporate many improvements which our experience shows to be advisable.

The new D-2 type machine is built generally on the same principle as former types, but simplified in construction. As an instance, in the A, B, C, types, it is necessary to shovel by hand into the conveyor the fine coal produced by the coal cutter, while in this type, we propose to load this fine coal just as the other coal is loaded.

Our present type machines have three chains—one cutter chain, and two conveyor chains. In our new D-2 type machine we have a single chain, which does both the cutting and conveying. There are also many other improvements.

The main drawings of this type D-2 cutting and loading machine are complete, and a portion of the work is in the shop, but some of the detail drawings have not been checked.

This machine will be particularly adaptable to thin seams, as the kerf cut by it will only be 2 inches high, and compared with a 6-inch kerf cut by all other types of undercutting machines. This advantage will be easily recognized by all coal producers.

We have encountered the usual "Doubting Thomas" attitude among some mining men, and the builders of old type mining machines; an attitude which is unfortunately too well understood by those who try to introduce advanced ideas or new type machinery. Some of this doubting has come from ignorance and some from selfishness. We believe, however, that all objections offered have been met, and the utility and practicability of the machine is now commended by all who have seen it in operation.

The coal mining industry generally, due to the scarcity and high cost of mine labor, are being forced into the use of more machinery, and in their anxiety to secure the same, they are in some cases being sold inefficient machinery.

The selection and proper application of new machinery will require very careful consideration of mechanical engineers and mining engineers; the mechanical engineers to develop and perfect the machinery, and the mining engineers to reorganize the mines and mining practices.

With this assistance, the change in the machinery and the reorganization of the industry will be a great benefit to the producers of coal, principally, and to the country in general.

VENTILATION AS PREVENTIVE OF MINE EXPLOSIONS

Sixty Percent Of The Big Explosions Have Been Caused By The Ignition Of Gas Which, In Turn, Has Ignited Coal Dust

GOOD ventilation is one of the most important means of preventing disastrous explosions in coal mines. This fact has been recognized for over a century, according to George S. Rice, Chief Mining Engineer of the United States Bureau of Mines, but it has not received enough attention, for at least 60 percent of the big explosions have been caused by the ignition of gas, which in turn has ignited coal dust.

Although mines are sometimes classified as gassy and non-gassy, no coal mine is free from the possibility of encountering gas, and encountering it most unexpectedly. Ignition of gas is prevented by the use of explosion-proof machinery, permissible explosives, and permissible miners' lights, and by the maintenance of rigid discipline. Nevertheless, so long as men are forgetful or careless in the use of open flames, so long as there is the possibility of machinery or materials failing, systematic ventilation will remain a most important safeguard in preventing explosions of gas.

Although an abundant volume of air may enter a mine, frequently, because of leakage along the airways, not enough fresh air reaches the workings to dilute and carry away inflammable gas. Generally it is at working faces that gas is most apt to enter a mine. Produced during the formation of the coal beds, the gas accumulates in crevices and joints and in the pores of the coal, and as mining advances it escapes into the workings, sometimes under high pressure as "feeders" or "blowers."

To obtain good ventilation the first need is a powerful fan on the surface; then come the construction of overcasts in airways to minimize the number of doors, the use of tight stoppings, and the "splitting" of the fresh air current to carry separate splits of fresh air to limited divisions of the mine workings. Any accumulations of gas in the workings should be removed by adequate ventilation after all the men but the foreman have been withdrawn from the mine. Experienced fire bosses, using permissible flame safety lamps, should frequently inspect the mine for the presence of gas and the percentage of gas in any split of the air current should be determined by analying samples of the air. For many years one of the largest companies in this country has daily sampled every ventilating split in its mines to determine the percentage of gas (methane) present, and it adjusts its ventilation accordingly, always keeping the methane content of the air in any split below one-half percent. Overcasts should replace doors as far as possible, and when used should preferably be built in units of two. In mines that make an appreciable amount of gas, line brattices should be used to conduct the air to each face that is beyond the last open cross-cut. In pitching beds the movement of the return air carrying methane, which is lighter than air, should be so arranged that it is ascentional or upward from the lower to the higher level in each split.

Too often it is found that, although there is a splendid fan and the ventilating arrangements along the main roads are excellent, the ventilation at individual faces is insufficient. It is in these places at the face that the greatest danger exists and where the most care should be exercised. If ventilation is adequate there, one of the greatest causes of disastrous explosions can be nearly eliminated.

MECHANIZATION OF COAL MINES

(*Continued from page* 359)

only be obtained by a judicious combination of types, each with its own proper function to perform.

The idea of cutting, mining and conveying at one and the same time and with one and the same machine, is interesting a number of people and should lead to important results, and we are to hear more on this subject tonight. The cable drag or hoe is being tried out in many places, but under an unnecessary handicap. The device looks ridiculously simple and therefore many operators are making the same mistake their brethren above ground made 10 or 15 years ago. They are using home-made outfits and as a result a good device is going to get a bad name.

Any mechanizing system will be at a premium which favors the pillar drawing part of room and pillar work, because of the large area of standing pillars throughout the country. In room and pillar work retreat lags behind advance so that rooms frequently stand for years. On top of the ground, rooms either cost or earn money, which is called rent. I have found it useful to charge standing room with a yearly rent, so called. This "rent" is obtained by dividing the cost of retimbering, relaying track, and clearing up falls at the end of the period, by the number of years the room will have to stand before the pillars are drawn. The effect of this in interesting the local authorities to reduce this time element, is astonishing. Such "rent" may amount to as much as a dollar a day per room, though this would be exceptional. Such information may be unpleasant, but it certainly helps to have the facts known and kept before the superintendent and foreman.

It is not unusual to hear, not too thoughtful criticism expressed of the conservatism and resistance to change met with around coal mines. We should understand and appreciate that such an attitude is not only natural, but inevitable and in many ways, desirable. Life itself below ground depends upon the correct interpretation of the signs and sounds, and the man who has learned the meanings of these warnings under a given system will naturally and rightly resist any changes which may lessen the value of his hard won experience.

In conclusion let me say that the interest in all this to the community at large, lies in the stabilizing effect which a general success in mechanizing the mines will have upon the coal producing industry. The beneficial effect on the industry from reduced costs, both direct and indirect, is obvious but perhaps it would mean still more if the number of companies operating were materially reduced. It is logical to anticipate a reduction in the number of companies operating, for several reasons:

First, many snow birds will drop out, because of the decreased margin available for them to work under.

Second, competition will gradually eliminate those mines which are unable to make improvements in their methods for any reason, be it either physical, mental or financial.

From the point of view of the soft coal industry, such stabilizing of conditions would be of incalculable value. The interest of the general public therein has been well put by the Engineering Council in this statement: "In the last analysis it is the consumer who will profit by any improvement in coal procurement."

BAD ROOF AND HEAVING BOTTOM AT SUGARITE MINE

(*Continued from page* 357)

barrier piller. A 200-foot room length has been tried, but great difficulty was met in driving that length. Also, through an error in entry sights, we at one time had room lengths of only 130 feet. In this case it was found that 130 feet solid coal was not enough to protect the working entry from the pressure resulting from the preceding worked-out entry. It therefore appears that a 150-foot room length is the correct distance for this particular situation.

The left-hand portion of the sketch, *Figure I*, shows this method of working. *Figure II* shows the method of timbering in these rooms.

In the right, or west, entries the cover is heavier and the tendency to squeeze greater; so a method differing from the east side is used. Pairs of entries are driven 300 feet apart to an arbitrary boundary of 1,400 feet. The coal is taken from one side only—the right side. The first entry is turned at right angles to the cross entry 20 feet back from the face and driven 300 feet to the worked-out area of the preceding entry. The inside 20 feet of coal is then pulled back. While this is being done the second entry, 108 feet outward, is being driven. When this second entry is up 250 feet a cross cut is turned west and driven 100 feet to the first entry before mentioned. From this cross cut three rooms are turned and driven 50 feet to the worked-out area and the pillars pulled at once, the inside pillar being mined first. Back 50 feet a second cross cut is driven and three short rooms worked as before. The cross cuts are 7 feet wide and the short rooms are 14 feet wide, 28 feet on centers. This system is continued until the entire panel is back to the 300-foot barrier pillar. The right-hand portion of *Figure I* shows this system in full operation.

In both the east and west sides of the main entry, the general plan of this method is to so time the operation in the different entries that the worked-out entries will establish a stepped break line of 45° with the main entries.

The main entry and air course are protected by taking down all the shale up to the 10-inch seam of coal and hauling it out of the mine. Timber sets are placed 6-foot centers with the legs set on top of the main coal seam. Lagging is used where necessary. This method of timbering has been very satisfactory in these entries which are driven on the face of the coal. It could not be used in the cross entries, which are driven on the butts, because the coal slips on the sides would shell off and let down the timber sets.

The two above-described methods of mining have been successfully used here for about 10 years. The timbering costs are extremely high, running at present 70 cents per ton of coal; but when it is understood that practically 100 percent of the coal is recovered the final result is satisfactory.

Concentration of operations is the essence of this method; and continuous operation of the mine, instead of three to four days a week as at present, would reduce this timbering cost somewhat.

Notwithstanding the heavy timbering costs and vigilance necessitated by this treacherous roof, the retreating system has proved its merits in the Sugarite mine.

MINE-RESCUE CHART

A chart containing detailed instructions in regard to the organization of rescue forces following mine fires or explosions has been issued by the Bureau of Mines for posting on mine bulletin boards.

The chart provides space for the name and address of the state district mine inspector, who, with the chief state mine inspector, should be notified immediately. An outline of general rescue organization and procedure is given with detailed instructions as to the special details that should be supervised by the mine superintendent, the mine foreman, the chief engineer, the director of safety and inspection, and other superintendents and foremen. The chart contains a list of recommended equipment for mine rescue stations, and a list of Bureau of Mines rescue cars and stations.

Copies of the poster may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Metal Mining Industry

MINING METHODS BEING USED AT RAY MINES

Swelling Ground And An Ore Body Composed Of A Large Percentage Of Schist, Which, Because Of Structure And Nature Of Ground Slacks When Opened Up, Makes Mining Methods At This Property Difficult

By ROBERT W. THOMAS*

THE purpose of this paper is not so much to explain the technical details of the mining method used at Ray as to describe in as few words as possible how the ground is prepared for mining, why it is prepared in this manner, and to anticipate and answer any questions that may come to mind when visiting the underground workings.

Mining low-grade ore bodies of this type by underground methods is mainly a drawing operation, as is well understood by all who are engaged in or interested in their exploitation.

The shape of the ore body and the nature of the ground have a bearing on the mining method. The ore body at Ray is almost entirely schist, and the structure and nature of the ground causes it to slack when opened up, with resultant sloughing, making it necessary to timber practically all drifts within the ore. The ground also, when under pressure such as is experienced in drawing sections, has a tendency to swell, making it difficult to maintain timbers.

The ore body is of irregular thickness and outline, being approximately 7,000 feet in length, and of varying width, with a maximum of 2,000 feet. The average thickness of the ore as shown by churn drill holes is 121 feet. The ore body in general strikes in a westerly direction and dips to the north. Throughout the major portion of the deposit, the south or foot wall side dips at an angle of 30 degrees to the horizontal, while the north or hanging wall side has no definite dip and is irregular. The ore body also sags in the center, having its highest elevation at the east and west ends. The difference between the high ore on the foot wall side of the ore body and the deep ore on the hanging wall side is approximately 700 feet.

This description of the deposit is very

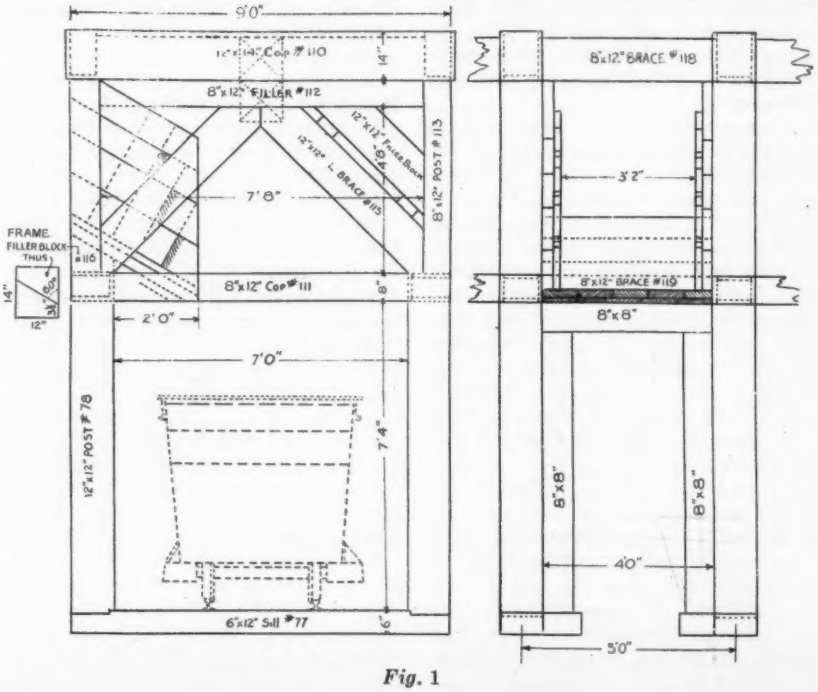


Fig. 1

* Mine superintendent, Ray Consolidated Copper Company. Paper delivered at the Ray meeting of the Arizona Chapter, American Mining Congress.

general, but will give some idea of its irregular shape and the necessity of opening up several haulage levels in order that the best economic extraction of the ore can be obtained. It has been found necessary to provide four main haulage levels, spaced at 150-foot intervals, with intermediate sub or hand-tramming levels tributary to the haulage levels to extract the outlying ore.

Owing to the comparatively small height of the ore above the haulage levels, it is necessary to use a method of mining that will allow for the greatest possible extraction of the ore above the haulage drifts, and this is done by having the draw points within the laterals themselves.

In describing the methods of preparing the ground for mining and drawing operations, the motor stoping areas will be first considered. Two methods are used in preparing the ground for drawing and the hardness of the ground determines which method shall be used. The preliminary or sill development work in each case, however, is exactly the same, and the method of preparing what is locally termed "Soft Ground" will be explained first.

In developing a motor section, parallel laterals, spaced at 40-foot intervals, are driven from a main fringe. These drifts are timbered with sets spaced at 5-foot centers, the details of which are shown in Fig. 1. In the preliminary driving, only the bottom sets are put in, excavation for the pony sets being made as required. Usually, four drifts are mined at a time, giving a width to the section of 160 feet, with an undercut of 100 feet along the drifts, making the area of the block to be drawn 100 feet by 160 feet.

Soft Ground

In preparing a block for drawing in soft ground, side stopes are carried up parallel to the laterals, the center of the stope in each case being 20 feet from the center of the drift forming the outer limits of the area to be undercut. Two end cut-off stopes are also carried up; these stopes being carried across or at right angles to the laterals, and are placed at each end of the block. All of these stopes are carried to capping, making a complete cut around the block that is to be drawn. Of course, after drawing operations have once been started, it is only necessary to carry one end cut-off stope as the other end of the block is already broken. These stopes are all regular shrinkage stopes and are provided with cribbed manways for the entrance of men and supplies. An open manway, consisting of a vertical raise, is also provided in advance which connects with a small drift driven on some higher horizon to provide ventilation for the stopes. The cribbed manways in the side and cut-off stopes are constructed of 3 x 6-inch cribbing 3 feet over all, making the inside of the manway 2 feet 6 inches in the clear.

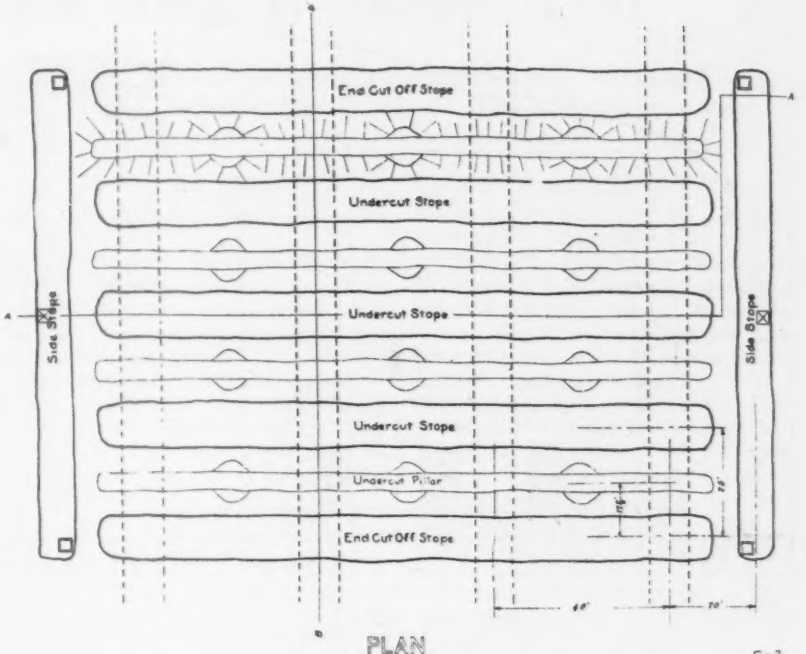


Fig. 3

After the side and end cut-off stopes have been completed, undercut stopes are carried at 25-foot centers within the solid portion of the block and at right angles to the haulage drifts. These stopes are carried to a height of 22 feet, when a final or fan-shaped round is put in. The undercut stopes are provided with cribbed manways similar to the side and end stopes, except that the cribbing is made out of 2-inch by 6-inch material so that it can be easily blasted out, also it is not necessary to have such a heavily constructed manway on account of the small height of the stope. No open manways are provided for the undercut stopes. The undercut stopes are carried up 10 feet in width and by the shooting of the

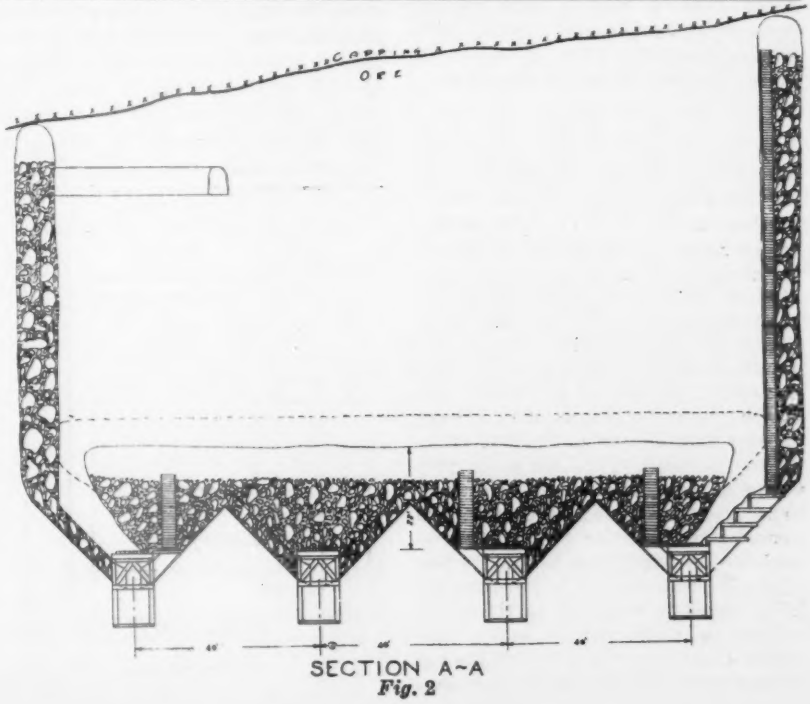


Fig. 2

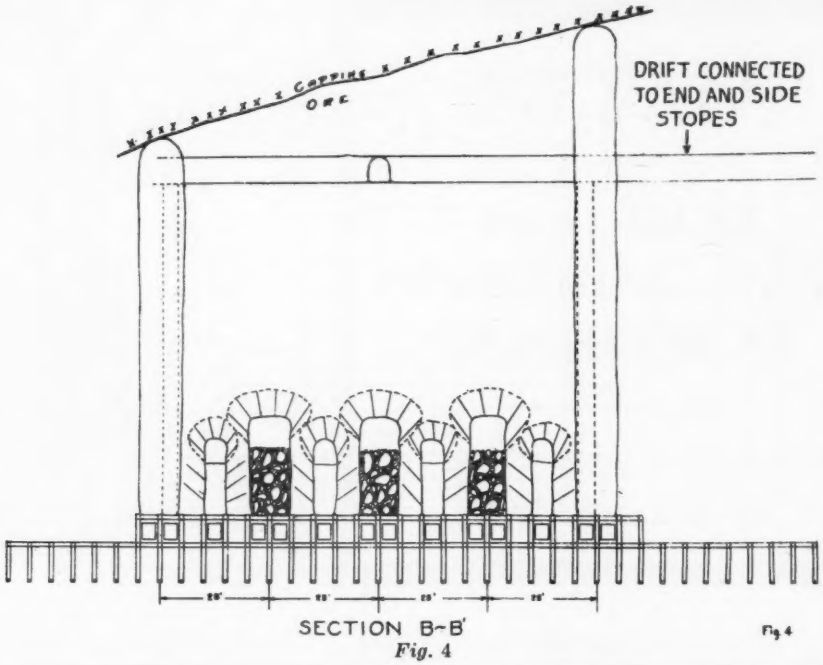


Fig. 4

final round are widened to approximately 20 feet.

After the undercut stopes are completed, pillar raises are connected across at right angles to the drifts and between the stopes. These raises are carried approximately 5 feet wide by 6 feet high and when completed are leveled up and widened on top of the cone position and are then drilled and blasted, thus making a complete undercut of the block. Fig. 2 shows in plan such a mining area, while Figs. 3 and 4 show sections through the block illustrating the undercutting operation. After the block is undercut, drawing operations are started.

Hard Ground

In hard ground that will not break up satisfactorily with an undercutting system, the original stope and pillar method developed at Ray is used. In this method no side stopes are carried up, the shrinkage stopes being carried across the block at right angles to the drifts and spaced at 25-foot centers. The stoping varies slightly from that described above in that a hook is carried in the ends of the stope to weaken the ends of the pillars. In carrying up the stopes, an effort is made to carry them as wide as they will stand so that as much of the ore as possible will be in a broken condition, the theory being that for satisfactory drawing the ground must be in as near a uniform condition as possible, either all broken or all solid, as is the case in undercutting. These shrinkage stopes are carried to the capping and at this point a final or fan-shaped round is put in to cut off the top of the pillar. Pillar raises are then connected across the block between the stopes, but in this case are carried up a short distance and widened out, and are really narrow stopes within the pillar. They are drilled and blasted when approximately 15 feet above the pony cap, but the condition of the pillar as to its safeness is usually the controlling factor in the height to which it is carried. The block is then ready for drawing.

Hand-Tramming

Hand-tramming sections are used to mine the outlying fringe ore which is at such an elevation above the haulage level that it is impractical to try to mine it directly into the haulage drift. The preparation of the ground for mining in these sections is exactly the same as in the haulage drifts, except that the drawing laterals are spaced at 25-foot centers instead of 40-foot centers, and a smaller drift is driven. Fig. 5 gives details of the timbers used in the hand-tramming sections. In the hand-tramming sections five to six drifts are taken as a block, making the section 125 to 150 feet in width; and usually 75 feet along the drift is prepared for drawing; as the ore over the hand-tramming sections averages about 60 feet in height, it is not necessary to undercut as great a length as in the motor sections.

The extraction drifts in hand-tramming sections are driven from and at right angles to a cross fringe in which the dumps are located. The dumps are so spaced that each dump serves three laterals and are arranged in such a manner that cars from each lateral can be dumped without interfering with the other laterals.

Other points in the operation of the mine which may be of interest are as follows:

Mining operations are carried on through two main shafts, one serving the eastern part of the ore body, and the other the western part. The skips in the main hoisting shafts are 10 tons capacity. At the collar of each shaft there is a coarse crushing plant which reduces the mine produce to seven-eights-inch mesh before shipment to the concentrator at Hayden, Ariz.

Underground haulage is conducted on 30-inch gauge track, with 8-ton, compressed air locomotives, and 5-ton capacity cars. The cars are of the solid box type and are dumped by three-car tipples into pockets having a capacity of 250 tons. The weight of rail in the main haulage tunnels is 45 pounds per yard, while 35-pound rail is used in the laterals and auxiliary fringes. In hand-tramming sections 18-inch gauge track is used with 12-pound rail and 1-ton capacity cars.

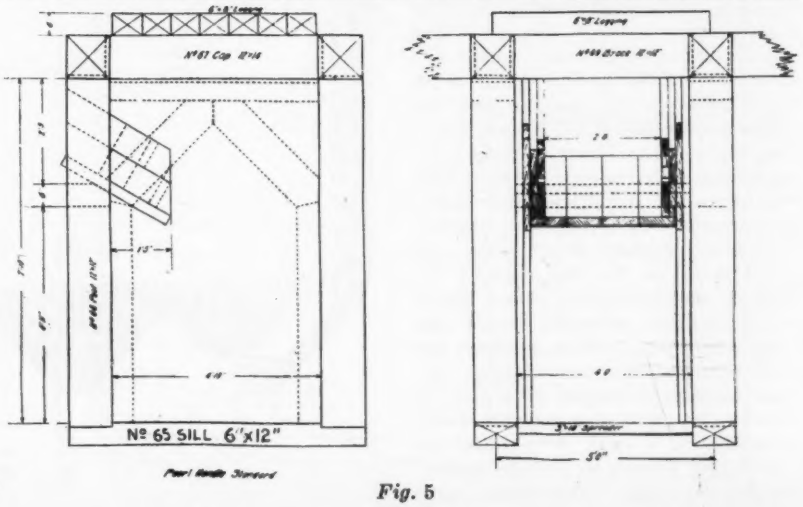


Fig. 5

REMODELED FLOW SHEET AT HAYDEN PLANT

Concentrator Operations Divided Into Five Sections—Fine Crushing In Roll Mill Circuit—Wet Gravity Concentration Roll Product—Fine Grinding Table Tailings In Tube Mill Circuit—Flotation Concentration Tube Mill Product — Drying Table Concentrates

By WALTER I. GARMS*

THE concentrator of the Ray Consolidated Copper Company, Ray mines, is located at Hayden, Gila County, Ariz.; distance 20 miles from the mine at Ray, Pinal County, Ariz., where the coarse crushing plant is located at the mine. Briefly, the operations of the concentrator are as follows:

First. Fine crushing in a roll circuit from through 1 inch to through 10 mesh.

Second. Wet gravity concentration of roll product on tables producing a finished concentrate.

Third. Fine grinding of table tailings in tube mill circuit to 10 percent on 100 mesh.

Fourth. Flotation concentration of tube mill circuit product, producing a finished concentrate and a reject tailing.

Fifth. Drying of table concentrates in settling bins and of flotation concentrates by filters.

The ore is received in cars, each of 60-ton capacity, and is dumped into bins of such capacity that, when filled, 10,000 tons are available without the necessity of resorting to any caving. Because of this capacity the trains operate only during the day shift.

The concentrator is divided into eight duplicate sections, each with a capacity of 1,500 tons per day. The remodeling of seven of these sections is approaching completion. The eighth section stands practically dismantled.

No attempt is to be made in this paper to give all the details, either mechanical or metallurgical, of the operations; it being the intention only to touch upon those points that would appeal to a practical operator.

The chief copper mineral occurring in the Ray ores is chalcocite, which has partially replaced pyrite. There are also present small amounts of sulphate, carbonate, and silicate, the last ranging from copper stained quartz to chrysocolla. The partial replacement of the pyrite by chalcocite has resulted in the presence of a considerable number of particles of what appears to be pure chalcocite, but which in reality contains a kernel of pyrite within a shell of chalcocite. This condition appears to exist in all the meshes ranging from the smallest measurable to the 10-mesh material produced by the rolls.

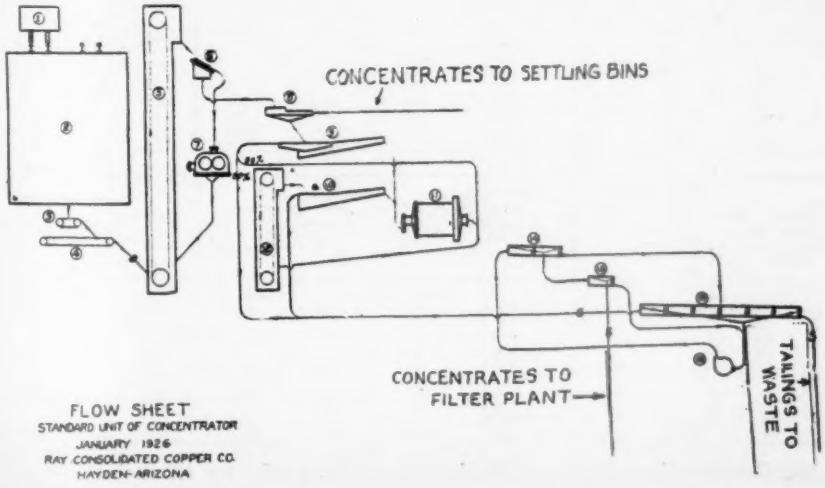
The ore is removed from the bottom of the bins by apron feeders, which dump onto short conveyors, which in turn discharge into the roll circuits of the individual sections.

Each roll circuit consists of two 42 x 16-inch Garfield rolls, operating at a speed of 125 r. p. m. in closed circuit with eight Chino type impact screens, each with an available screening area of 8.78 square feet, which is covered with 8-mesh .063-inch wire, double crimped screen cloth. A 30-inch wide elevator belt, operating at a speed of 400 feet per minute and covered with a double row of 9 x 9 x 15-inch buckets, staggered, and approximately 19 inches apart along the length of the belt, provides for the closing of the circuit. The original feed is dumped into the elevator which discharges onto the screens. The oversize from the screens passes through the rolls and into the elevators. The screen undersize flows to the gravity concentration department. The grinding in the roll circuit is wet. The lime, which is used for the double purpose of neutralizing any acid condition and for the maintenance of the proper alkalinity for flotation operations, is added in this circuit. The roll steel consumption is .25 of a pound per ton of original ore. The power consumption in this circuit is 4.01 kilowatt hours per ton. All the equipment is very handily served by a 20-ton capacity crane, which runs the entire length of the building. A summary of data covering the results of operations for the last quarter of the year 1925 is given later in this article and in itself clears the reason for the use of rolls for this stage of the grinding.

In the gravity concentration department there are 12 triple Plat-O tables on each section. These tables operate at a speed of 254 strokes per minute, with a throw of 15/16 inches. The table deck is 5 x 14 x 6 feet and has a pitch of 1 inch. Approximately 44 percent of the final concentrate is produced at this point. These concentrates are pumped to the settling bins, which are located parallel to the railroad track, where they are dewatered simply by letting them stand in the bins for a two-days period. The table tailings go to the tube mill circuit by gravity.

The tube mill circuit consists of one 8 x 28-foot bowl type, drag classifier, with an 18-foot bowl, two 8 x 28-foot drag classifiers, operating at a speed of 17 strokes per minute; two 7 x 10-foot tube mills, operating at a speed of 16½ revolutions per minute, and two short, single-

* Mill superintendent, Ray Consolidated Copper Company. Paper delivered at the Hayden meeting of the Arizona Chapter, American Mining Congress.



FLOW SHEET
STANDARD UNIT OF CONCENTRATOR
JANUARY 1926
RAY CONSOLIDATED COPPER CO.
HAYDEN-ARIZONA

LEGEND

1. 60-ton ore cars.
2. Ore bins, 3,200 tons.
3. Two apron feeders, 30" wide. Travel 12' per min.
4. Conveyor. 20" belt. 230' per min. belt speed.
5. Elevator. 30" belt. 15"x9"x9" buckets, spaced 19" alt. Belt speed 400' per min. 60'-6" c. to c.
6. Eight 3'x4' impact screens. 576 vibrations per min. 8 mesh. .063" wire.
7. Two 42"x16" Garfield rolls. 125 R. P. M.
8. Twelve triple Plate-O tables. 254 strokes per min. 15/16" stroke. 1" slope.
9. One 18' diam. bowl class. 2 R. P. M. 8'x28'-4" drag. 17 strokes per min.
10. Two 8'x28'-4" drag classifiers, 17 strokes per min.
11. Two 7'x10' tube mills. 16.4 R. P. M. and 16-2/3 R. P. M.
12. Two elevators. 16" belt 24'-4½" c. to c. 369 F. P. M. 15"x9"x9" buckets, spaced 18".
13. Flotation roughers. 2 duplex rows. Total 24 cells. Cells 15' long by 30" wide by 24" deep at shallow end. Bottom slope ½":12. 313 sq. ft. blanket area.
14. Flotation cleaners. 2 duplex rows. Total 8 cells, same dimensions as roughers.
15. Flotation recleaners. 2 duplex rows. Total 4 cells.
16. One 8" centrifugal pump for 8 duplex rows.

S. Samplers.

Ray Consolidated Copper Company—Hayden Plant—Milling Statistics Fourth Quarter—1925

Dry tons ore milled						722,900
Heading			% Tot. Cu.	1.516	% Ox. Cu.	.205
General Tailing			% Tot. Cu.	.193	% Ox. Cu.	.140
General Concentrate	% Cu.	17.952	% Fe.	25.97	% Insol.	19.65
Gravity Concentrate	% Cu.	15.404	% Fe.	34.57	% Insol.	7.09
Flotation Concentrate	% Cu.	19.834	% Fe.	19.61	% Insol.	28.93
Extraction	% Tot.	88.20	% Sulphide	96.23	% Oxide	36.90
Lbs. crude lime per ton crude ore milled						5.32
Lbs. free CaO per dry ton flotation feed						.69
Lbs. roll steel per dry ton crude ore						.258
Lbs. semisteel grinding balls per dry ton ore milled						.79
Lbs. tube mill liner consumption per dry ton ore milled						.09
Lbs. 100% xanthate per dry ton flotation feed						.085
Lbs. Yarmor pine oil per dry ton flotation feed						.175
Lbs. blast furnace oil per dry ton flotation feed						.018
Tons primary water used in mill per dry ton ore milled						2.99
Average life of roll shell—days						31.26
Average life of tube mill—5-inch silica liners—days						260
Average life of tube mill—2-inch cast liners (with lifter bars)—days						450
Average life of tube mill—3-inch cast liners (wave type)—days						350

Mill Power Consumption

	K. W. Hrs. Per Ton Ore	Subtotal
Coarse Crushing (at mine)	.35	.35
Roll circuit	4.01	
Tube mill circuit	3.79	
Gravity concentration	.17	
Flotation concentration	3.10	
Dewatering—Filtering	.37	
All other machinery	.48	11.92
Primary water	1.05	1.05
Industrial buildings	.10	.10
Grand total		13.42

bucket elevators, operating at a speed of 369 feet per minute. The power used in the tube mill circuit is 3.79 kilowatt hours per ton of original ore. The table tailings discharge into the bowl classifier, which overflows a product averaging 1 percent on 100 mesh. Approximately 20 percent of this overflow product is used as a classifying medium for the circulating drag classifiers. The rake discharge of the bowl classifier is split evenly between the two mills, each mill being in closed circuit, via a short elevator, with one of the straight drag classifiers. The combined product of the bowl type and straight drag classifiers, averaging 10 percent on 100 mesh, passes to the flotation plant. The drag classifiers have been in operation for over a year, during which time, because of their slow speed and ample capacity, it has been practically unnecessary to make any repairs thereon.

The feed to the mills is maintained at a density of 80 percent solids. The 3-inch semisteel balls are an Arizona product and the consumption per ton of original ore ranges from 7/10 to 8/10 of a pound. Because of the speed of the mills and the density of the pulp, no breakage whatever is experienced with the balls.

Efficiency tests have been conducted to determine the relative merits of 3-inch balls, 2-inch balls, 3-inch balls with heavy risers and cubes, with the result that the relative efficiencies, in this particular circuit, were in the order named. From the experience gained in these tests the use of any other than true spherical shaped grinding medium has been put out of consideration for this service.

An interesting feature of the mills recently installed is the use of the helical gears in a single reduction type for the deliverance of power. It is believed that this is the first installation where gears of this type have been used in a tube mill installation.

The combined product of the individual tube mill circuits is assembled at two points, where it enters two 26-inch pipe lines for conveyance to the flotation department. (*Continued on page* 378)

Opening or mesh	Feed to roll circuit 1,500 tons per day.		Product of roll circuit. 1,500 tons per day. 57% solids.		Feed to tube mill circuit. (Table tailings.) 1,450 tons per day.		Table concentrate. (Smelting Product) 50 tons per day.		Product of tube mill circuit. (Head to flotation). 1,450 tons per day. 26% solids.		General mill tailings (Flotation tailing) 1,385 tons per day.	
	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.
1.05"	2.0	2.0										
.742"	15.0	17.0										
.525"	15.5	32.5										
.371"	13.0	45.5										
3 mesh	8.6	54.1										
4	7.6	61.7										
6	4.5	66.2										
8	4.0	70.2										
10	3.7	73.9										
14	2.7	76.6	1.1	1.1	1.0	1.0	2.5	2.5				
20	2.1	78.7	6.4	7.5	6.3	7.3	8.3	10.8				
28	2.0	80.7	8.9	16.4	8.7	16.0	14.5	25.3				
35	2.0	82.7	8.8	25.2	8.6	24.6	12.6	37.9				
48	7.7	84.4	6.4	31.6	6.0	30.6	18.1	56.0				
65	1.6	86.0	5.8	37.4	5.5	36.1	16.9	72.9	1.2	1.2	1.2	1.2
100	1.4	87.4	6.0	43.4	5.7	41.8	15.5	88.4	6.2	7.4	6.4	7.6
200	1.0	88.4	8.1	51.5	8.1	49.9	8.5	96.9	15.1	22.5	15.1	22.7
−200	11.6	100.0	48.5	100.0	50.1	100.0	3.1	100.0	77.5	100.0	77.3	100.0

Opening or Mesh	Flotation Concentrate (Smelting Product) 65 Tons per day.		Primary Class. Sands. Feed to 2 Tube Mills. 725 Tons per day. 80% Solids.		Primary Class. Bowl Overflow. (To Flotation 575 Tons per day.) (To Circulation 150 Tons per day.) 20% Solids		Circulating Class. Sands. Two Classifiers. Feed to 2 Mills. 2,275 Tons per day. 80% Solids.		Circulating Class. Overflow. 2 Classifiers. (To flotation 875 Tons per day.) 30% solids.		Tube Mill Discharge. Two Tube Mills. 3,000 Tons per day.	
	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.	% Matl.	Cum. % Matl.
14			2.0	2.0								
20			12.7	14.7								
28			17.3	32.0			6.9	6.9			5.0	5.0
35			17.3	49.3			12.8	19.7			9.0	14.0
48			12.0	61.3			17.3	37.0			13.0	27.0
65	1.0	1.0	11.0	72.3			19.7	56.7	2.2	2.2	16.6	43.6
100	3.5	4.5	10.3	82.6	.9	.9	17.3	74.0	9.5	11.7	15.9	59.5
200	12.6	17.1	8.4	91.0	8.1	9.0	13.5	87.5	19.7	31.4	15.7	75.2
−200	82.9	100.0	9.0	100.0	91.0	100.0	12.5	100.0	68.6	100.0	24.8	100.0

Screen analyses of mill product in new Ray Con. flow-sheet, based on 1,500 dry tons of No. 2 mine ore per section day.

PNEUMATIC PLACING OF CONCRETE AT RAY

To Meet A Condition Of Swelling Ground, Which Made Impossible Good Condition Haulage Drifts Capable Of Handling Large Tonnages, This Company Has Developed A System Of Placing Concrete Pneumatically That Has Greatly Reduced Their Difficulties

By CYRIL A. ROBOTHAM*

THE need of some class of support other than timber has been experienced by mining companies and others where permanent openings had to be made in swelling ground, or other kindred conditions which made it next to impossible to maintain them by ordinary timbering methods.

Steel in the form of beams and posts, and circular rings of brickwork and steel have been tried with little better results.

It was thought that if a tunnel or opening could be lined with some material that would fill every void and at the same time be strong enough to resist ground pressure and the destroying action of air, that such places could be maintained without excessive expense.

Concrete placed by hand was resorted to with moderate success; the difficulty of filling all voids with the methods used, and the added expense of labor were serious items to be considered.

Pneumatic placing of concrete was developed, and, after the preliminary difficulties were eliminated, has now come into general use by mining companies, contractors, and railroads in all parts of the world.

There are two methods of pneumatic placing in general use. By one method the pneumatic machine is placed at the mixing plant, conveniently located for delivery of material, and pipe lines for conveying the wet mix are laid from the plant to the forms. By the other method the machine is located at the forms, and the wet mix is conveyed in cars to the machine and then placed in the forms by air. Such machines are patented, restricted articles, leased by the owner to the user on a yardage basis.

The success of either system depends in great measure on having available sufficient compressed air without crippling more important operations. Concrete may be easily conveyed 2,500 feet without additional equipment; above this distance, air consumption is excessive. A serious limitation is the forcing of concrete up vertical pipes.

Costs compare favorably with other methods. Extra air costs are more than hidden by added speed and flexibility, with consequent cheaper costs per foot and yard.

Speed of work depends on local conditions. At Ray an average of 30 feet of 7′ 0″ x 8′ 0″ drift has been concreted per day of two shifts in tunnel work, and on heavy pillar and beam work in stations as much as 130 yards have been conveyed 1,000 feet and placed in approximately 12 hours.

Before discussing more fully the use of pneumatic machines at the Ray mines, it may be of interest to explain the chief reasons and causes that made it necessary for this company to investigate this method and eventually put it into extensive use.

In the year 1916 development of the third level of the No. 2 shaft was started and it was found that the swelling nature of the ground would make it next to impossible to maintain in good condition haulage drifts capable of handling large tonnages without interruptions over a number of years. This was quite a serious situation and efforts were made to find out what was done elsewhere when similar conditions occurred. In the meantime, experiments with different forms of hand-applied concrete were tried, with little or no success.

Information was finally secured about a system of pneumatic placing of concrete in tunnels that appeared to be successful. This was investigated and it was decided to give this method a trial, and, as it was something different from ordinary mining methods, the Foundation Company was called in to direct the work.

Lining was started at the mine end of the 7′ 0″ x 8′ 6″ drift to the tipple. Two thousand four hundred and thirty-seven yards of concrete were placed, at a total cost of $52.41 per foot of tunnel completed, equivalent to a cost of $24.75 per yard of concrete placed. As this was a proven success, the work was extended, taking in all openings adjacent to the third level station, with an average cost of $25.65 per yard; 7,813 yards of concrete being used in the total project. Several small jobs were subsequently accomplished by the company with complete success.

In the latter part of 1922 it was decided to provide additional storage at the No. 2 shaft by constructing a 48-foot by 144-foot steel bin, similar to the one at the No. 1 shaft, with reinforced con-

* Construction engineer, Ray Consolidated Copper Company. Paper delivered at the Ray meeting of the Arizona Chapter, American Mining Congress.

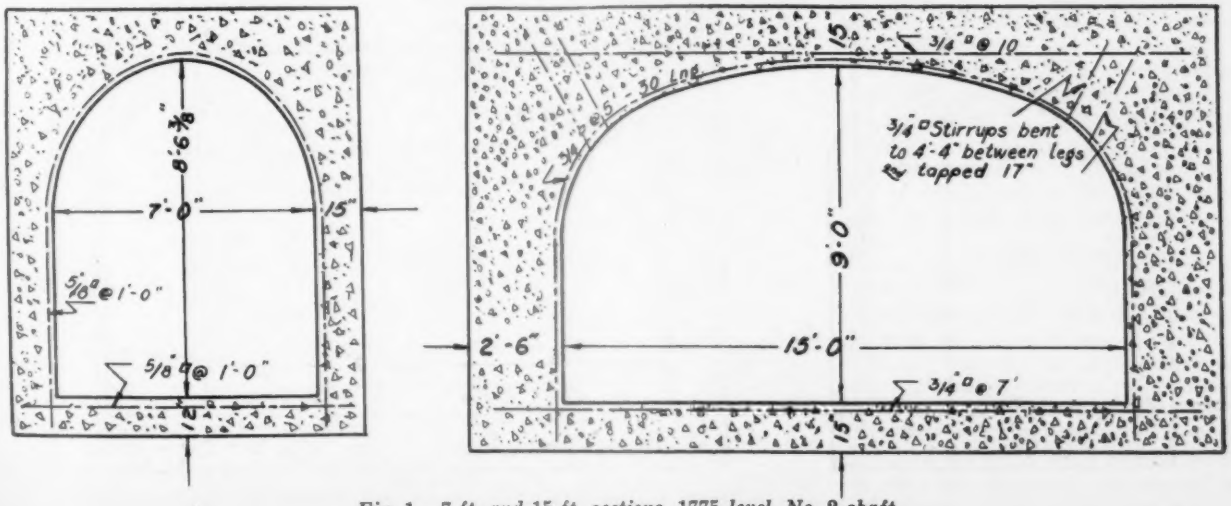


Fig. 1.—7-ft. and 15-ft. sections, 1775 level, No. 2 shaft

crete foundations. Several methods of placing the concrete were discussed, but as there was already a central mixing plant at the No. 2 incline, adjacent to the proposed bin, it was decided to use the pneumatic method on this work, and 1,011 yards of concrete were placed, at a total cost of $20.46 per yard. This cost includes all work on foundations except excavation.

Upon the completion of this bin, the gun was again sent into the mine to start lining the new fourth level at the No. 2 shaft. Development on this level had shown similar, if not worse, ground conditions than the third level mentioned before. This work is still in progress. Satisfactory costs are being obtained on drifts 7 feet 0 inches by 8 feet 6 inches to 10 feet 0 inches by 24 feet 0 inches, and equal previous performances. To date, a total of 4,915 yards have been placed, with an average cost of $22 per yard.

Another job where pneumatic placing has been successfully applied is the concreting of a drain tunnel driven in 1913 and 1914. In order to eliminate further expense in repairs and maintenance, it was decided to line this tunnel with concrete, and some 3,344 feet of 7 feet 0 inches by 7 feet 5 inches and 7 feet 0 inches by 8 feet 11 inches tunnel was lined, at an average cost of $22.06 per foot, using 3,322 yards of concrete, at a cost of $22.20 per yard. A 190-foot diversion wall was also built at the intake of the drain tunnel, using some 1,123 yards of concrete, at a cost of $13.29 per yard. These figures include all charges except excavation.

Summarizing costs as mentioned above, we have:

1916-17, 3-level, No. 2 shaft, 7 feet 0 inches by 8 feet 6 inches, $24.75 per yard.

1916-17, 3-level, No. 2 shaft, total project, $25.65 per yard.

1923, new ore bin foundations, $20.46 per yard.

1924-26, 4-level, No. 2 shaft, total to date, $22 per yard.

1925, drain tunnel, total, $22.20 per yard.

1925, diversion wall, total, $13.29 per yard.

The pneumatic installation at Ray is a modification of the central mixing plant type, more or less combining the two systems described above. The gravel bins and concrete mixer are on the surface, located at a convenient point for delivery of material. After the concrete is mixed it is discharged into a 6-inch pipe where it flows by gravity into a hopper in the mine, from whence it is drawn into the gun and conveyed by air through another 6-inch pipe line of variable lengths to the forms.

All concrete used at the Ray plant has been made from creek bank run, selected as to quality and size only, and without screening. Picking out large rocks and cleaning off silt deposit are done by hand at the point of loading.

Underground, the ordinary mix used is one part cement to five parts of creek gravel. However, if thin slabs have to be placed, of an important nature, the cement is increased according to standard practices. Tests have been made of the Ray gravel from time to time with satisfactory reports as to sizes and quality of material, and have given good results from test cylinders.

Forms used at the Ray plant are mostly of wood, except in the case of the drain tunnel where collapsible steel forms were used, and all work is now being done by mine labor. Average care at joints shows smooth, clean concrete when stripped. The quantity of water used at Ray is about normal. No great excess of water is apparently required for this class of work for proper delivery of material to the forms. However, it is necessary to use more water as the horizontal distance increases that the concrete has to be conveyed by air, and in accordance with the quantity of reinforcing steel in the forms. Spading of the wet mix as it enters the forms is practiced whenever possible. All latents collecting at the top are skimmed off, if connections have to be made at a later date.

Attached will be found drawings illustrating the work.

1. Drawing No. 1 illustrates the concrete installed on the third level of the No. 2 shaft.

2. Drawing No. 2 illustrates the concrete installed on the fourth level of the No. 2 shaft. It will be noticed that the general design has been changed. This change makes it easier to install the form work, doing away with expensive labor. An increase has been made in the reinforcing to take care of added loads and change in design.

A study of requirements for electric-furnace refractories is being made by the Bureau of Mines. The work on this problem will follow in a general way the line of attack used in the bureau's study of the open-hearth refractories problem. It will include a survey of general conditions and the gathering of data on refractories used, service life, probable cause of failure, etc.

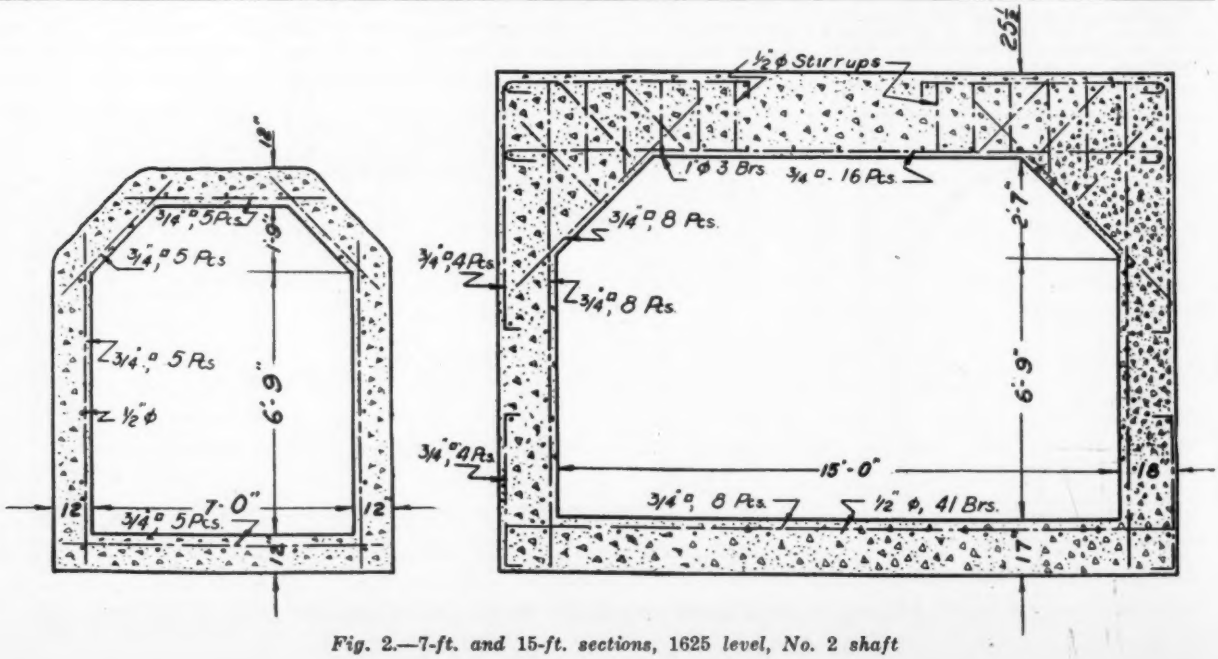


Fig. 2.—7-ft. and 15-ft. sections, 1625 level, No. 2 shaft

WATER DEVELOPMENT FOR THE HAYDEN PLANT

The Comparatively Large Area Of Ground Available For Economic Tailings Disposal And The Certainty Of An Ample Water Supply Are The Two Main Factors Which Caused The Location Of This Company's Concentrator Approximately 20 Miles Away From The Mine

By NELS JOHNSON*

THE Hayden millsite, although not ideal, is a very satisfactory one, and combines facilities and necessities not found in many millsites. Among the more important of such facilities and necessities are:

1. A millsite convenient to an already established railroad and sufficiently large to accommodate the concentrator and its auxiliaries.

2. A tailings disposal area of 1,000 acres of ground so located that it will serve the plant for 35 years without the necessity of resorting to pumping or other mechanical means of depositing such tailings, or an elaborate and expensive system of laundering for its disposal.

3. A water supply which can be developed to a great deal more than any anticipated requirements.

The comparatively large area of ground available for economic tailings disposal and the certainty of an ample water supply are the two main factors which caused the location of this company's concentrator approximately 20 miles away from the mine.

The subject assigned to me concerns the water supply and its development for use at the Hayden plant, and I will endeavor to give such information as may be of interest concerning:

1. The source of water supply.

2. The two methods of water development:

An ample water supply is one of the prime considerations when selecting a

a. Open well system.

b. Air lift water system.

millsite for a gravity concentrator, a townsite or a steam power plant. The concentrator, power plant, and townsite for the necessary employes of the Ray Consolidated Copper Company are located at Hayden; also the smelter of the American Smelting & Refining Company and its townsite. All of these obtain their water from the same source and their gross water requirements have varied between 6,000,000 and 12,000,000 gallons per day, the variations being dependent upon the concentrator flow-sheet and output, and seasonal townsite requirements.

SOURCE OF WATER SUPPLY

When one stands on the millsite at Hayden and looks down into the valley less than 1½ miles distant and observes the junction of two good sized rivers, his first impressions naturally are that a water supply of 10,000 to 12,000 g. p. m. should be easy of development within the immediate vicinity. An exploratory boring made in the ground adjacent to the rivers would be convincing, and especially so, if the investigation were made during the winter months, or following an extended rainfall along the rivers' watershed, as the water might be found within 10 or 15 feet of the surface. It is in this valley and not far from the junction of the San Pedro River, with the Gila River, that Hayden and its industries obtain their water supply.

The pumping plant which supplies all water necessary for the Hayden plant is located 1 mile south of the concentrator in Hayden and one-half mile north of the intersection of the Gila and San Pedro Rivers, in a valley formerly used for agricultural purposes. The company's water development lies entirely north of the river and no explorations have ever been made in the river bed proper or south of the river.

The length and breadth of the water bearing formation in which the water development has been made has never been determined. It may extend for miles up the San Pedro River, but surface indications are that same does not extend for any great distance up the Gila River.

The depth has been fairly well determined. Fourteen wells of from 100 to 850 feet in depth have been sunk within the explored area and the ground formation disclosed indicated from 10 to 15 feet of silt near the surface, covering a broad extensive water bearing formation of porous material of fairly uniform character, consisting of sand, gravel, and a comparatively few small boulders, and from 60 to 75 feet in depth. The porous strata overlays an impervious strata of clay and conglomerate of unknown thickness. One exploratory test hole was drilled to a depth of 850 feet, and the log of such hole showed nothing but hard clay and conglomerate below the 80-foot level. *Figure* 3 gives a typical section through the top 100 feet of the area containing the water development.

WATER DEVELOPMENT

The development of the water supply at Hayden and its industries may be thought of as having been made in two distinct periods:

1. The initial development, consisting of shallow, open wells of large diameter and deep cuts, or trenches, excavated into the water bearing strata.

2. The air lift water system consisting of smaller drilled wells extending into the deeper water bearing formations.

The initial development was begun in the year 1910, and after over eight years of practically continuous expenditure of labor in making extensions so as to obtain and maintain an ample supply of water, it was abandoned in the spring of the year 1919. At that time the open well system was replaced by an entirely independent air lift water system, which to this date has proven satisfactory in all respects, and above all other factors,

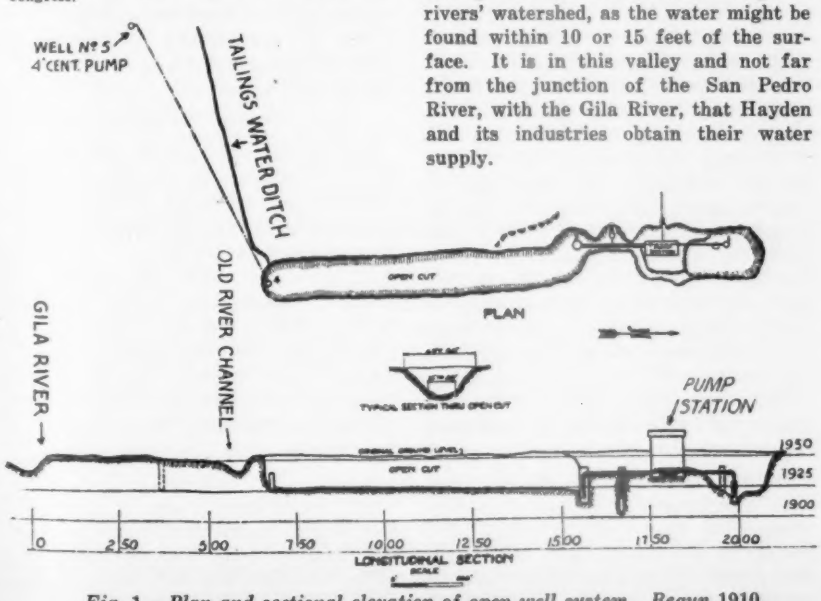


Fig. 1.—*Plan and sectional elevation of open well system. Begun* 1910. *Abandoned* 1919

* Mechanical Engineer, Ray Consolidated Copper Company. Paper delivered at the Hayden meeting of the Arizona Chapter, American Mining Congress.

it has taken the worry out of the water situation.

Open Well System

The original water development was begun in January, 1910, and consisted of one large open well (Well No. 1, see *Figure* 3), about 200 feet in diameter at the top, excavated to the water level and dredged to a total depth of 35 feet. The sides of such open cut were intended to have slopes of 1½ to 1, but they were continually caving and gradually approached the vertical. The caving of the sides produced muddy water which was objectionable, and the caved material which settled, choked up the pervious formation in the bottom. The anticipated capacity for this well was never realized, even at the beginning, and decreased continually, and it was found necessary to maintain a force of workmen to prevent the bottom from clogging.

Perforated caissons, 8 feet in diameter, were sunk in the bottom of Well No. 1 to still greater depth, and the suction pipe of the plunger pumps was installed therein. This improvement increased the well capacity and reduced the previous manual labor requirements but was not satisfactory.

During the years 1911 and 1912 four more wells, ranging from 8 feet to 25 in diameter, and from 25 feet to 45 feet in depth, were dug within a radius of 1,500 feet of the pumping station. One of these, Well No. 5, was destroyed by a flood in the Gila River in December, 1914. Centrifugal pumps were installed in Wells 4 and 5 to deliver the water to the suction of the plunger pumps and tests were often made which showed the capacity of these two 20-foot diameter wells varying between 100 and 500 g. p. m. each. It may be of interest to compare the capacities of these 20-foot diameter wells with the 500 and 1,200 g. p. m. capacities of the 16-inch diameter wells, which were constructed in the years 1918 and 1919 as integral parts of the air lift water system.

Up to the year 1913 no reserve water supply had been developed, but the mill tonnages were steadily increasing, and water demands were increasing in proportion.

The next addition to the water development was to construct an open cut at right angles to the general direction of the underground flow. The length of the cut was to be such as would produce the requisite amount of water. The ultimate dimensions of this open cut, which is still to be seen south of the pumping station, are: Length, 1,000 feet; width at top, 80 feet; depth, 25 to 30 feet. This open cut was similar in construction to the first open well constructed north of the pumping plant and their combined length, including the excavation for the pumping plant, was 1,600 feet.

During the periods of high water the water development made so far was ample to supply the requirements of 10,000,000 gallons per day, but the turbidity of the water was high, due either to the constant caving of the banks of the open cut or to bottom cleaning operations. The muddy water proved objectionable for power house and smelter use; and the silt and sand reduced the life of the wearing parts of the plunger pumps. During the dry seasons the supply was insufficient and the drawdowns produced excessive suction lifts of between 15 and 20 feet for considerable periods. These excessive suction lifts caused undue maintenance and repair costs for the plunger pumps and the discharge pipe lines, and materially affected the mechanical and volumetric efficiencies of such pumps.

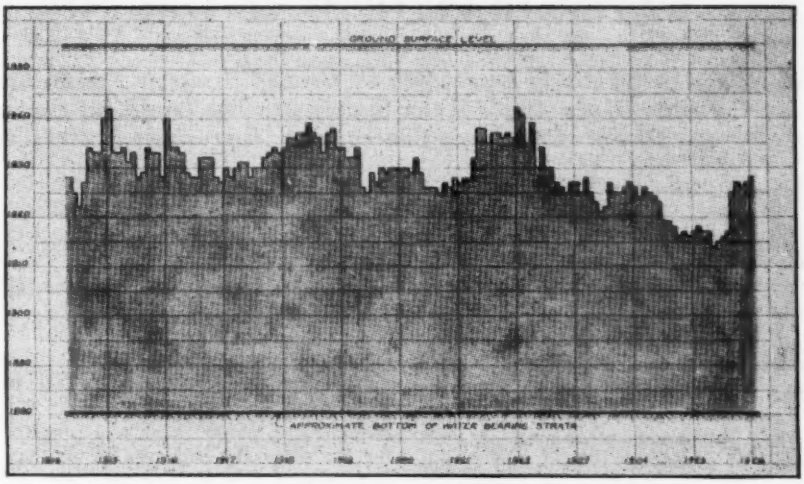


Fig. 2.—Fluctuations in water levels during the 12-year periods noted. Elevations based on monthly readings

Silt deposits in the bottom of the open cuts and wells clogged the pores, causing a reduction in the flow of water, and it was found necessary to remove such deposits every two years. It took two months' time to clean the bottoms, during which period the water as delivered to the pumps was dirty as before mentioned.

The open well system as just described proved inefficient, unreliable, costly as regards first cost, expensive as regards maintenance, and with all more or less hazardous risk in that it would not be the impossible for the treacherous Gila and San Pedro Rivers, at flood times, to break through their banks and fill up or destroy the whole well development. This assumption was not exactly remote, as in the years 1914 and 1915 the flood waters were within 1 foot of overflowing the river banks and into the open cut.

During the year 1918 slightly more than 4,000,000,000 gallons of water were pumped, or an average of about 7,700 gallons of water per minute for the entire period. According to the well reports for this same period, from 1,100 to 4,700 gallons of water per minute were either reclaimed from the tailings or taken directly from the river at a high annual expenditure for the water thus reclaimed, and such surface water was not the most desirable. One deep well was furnishing about 800 g. p. m., which would leave only slightly more than 4,000 g. p. m., as the average capacity during the year 1918 of the then extensive open well water development.

The conditions as enumerated above caused much worry and inconvenience and the maintenance expense proved excessive. To overcome these conditions the construction of an air lift water system was begun during the fall of the year 1918, and was completed and operating successfully in May, 1919. The wells of this plant have actually delivered over 12,000 gallons of water per minute at a 22-foot lift, which is nearly three times the capacity of the open well system with the same water level conditions. The approximate total cost of the 10 new wells, reservoir, and compressors was $150,000.

The Air Lift Water System

The air lift water system consists of a series of shallow wells with air lift pump installations, the water from which is conveyed by means of underground pipe lines to a common reservoir. The reservoir is located convenient to the old pumping station and at such an elevation as to provide a suction head on plunger pump valves. The air for the air lifts in the wells is produced by either one, or any combination, of three compressors located within the compressor room in the pumping station.

Wells

The well system of the air lift water installation consists of eleven 16 inch, inside diameter, cased wells 100 feet deep, drilled through the full depth of the water-bearing formation previously described, and some distance into the im-

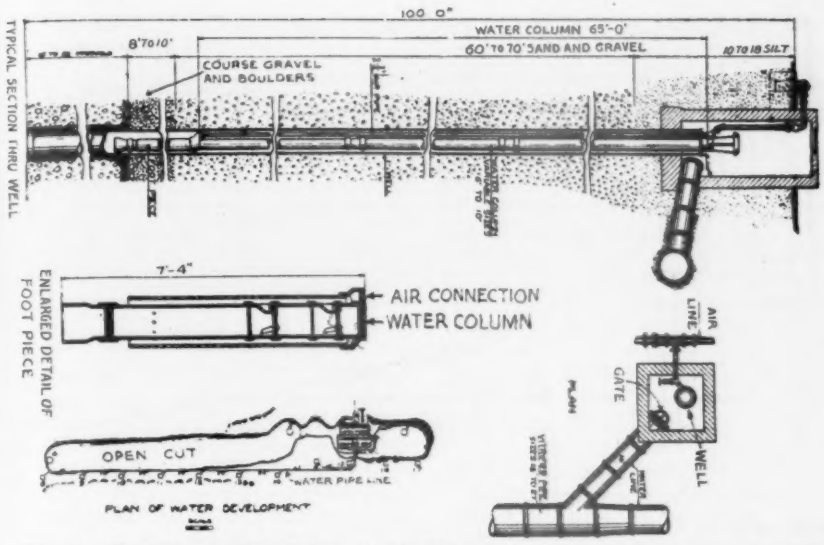


Fig. 3.—Typical well installation of air lift water system. Also plan of air lift water development. Construction completed in 1919

pervious material so as to insure proper submergence for the air lift pump. These wells are spaced from 120 to 143 feet apart and are located in an approximately straight line which is at right angles to the general direction of flow of the underground water. The farthest well is located nearly 1,400 feet from the air compressors.

Capacities of the individual wells were determined quite closely by 10-hour tests made upon the completion of the drilling of each well and varied from 500 to 1,200 g. p. m.; and all but one was given a rating of 1,000 g. p. m., or over, at 22-foot lift. In this one well of 500 g. p. m. considerable depth of quicksand was encountered and the casing perforations were discontinued near the top of the quicksand, which is the probable cause of its small capacity.

By referring to *Figure* 3, which shows a section through a typical well, you will observe that the enlarged chamber at the well discharge is of concrete. The tops of the concrete chambers on nine wells are above the tops of the concrete walls of the pumping station, and as the tops of such walls are higher than any anticipated flood level conditions in the adjacent rivers, the possibilities of the water development being destroyed by floods have been eliminated. Below the concrete chamber the well casing of 10 wells consists of two thicknesses of 10-gauge steel. From 20 to 30 triangular shaped perforations, ⅝" at base and 2½" long, were punched through the casing after its installation, the perforations beginning about 20 feet below the ground surface and extending to the bottom of the water-bearing formation. One well, Well No. 6, has a patented casing which is described by the manufacturers as a shutter screen, and is made with a horizontal louvre effect through which the water has an upward movement. This type of casing, with a high first cost, has proven unsatisfactory, in that the perforations clog, a condition which has reduced the well capacity to about one-third of the original.

The wells are dependent entirely upon an underground flow of water filtered for a considerable distance through a sand and gravel formation which makes clean and clear water a certainty, safe against possible surface pollutions, thus overcoming more of the serious objections to the old well system.

The 11 wells are connected to a common reservoir by means of three independent water pipe lines ranging in size from 16 inches to 27 inches in diameter; and to the air compressors by three independent air lines. The water lines are underground and are vitrified sewer pipe, this pipe having been selected in preference to steel or wood because of its durability, and its estimated lower coefficient of friction after several years of service. The air distributing pipes are on the surface and are so arranged as to divide the well system into three parts, consisting, respectively, of two, three, and six wells, with such control that any combination from 2 to 11 wells is possible through the manipulation of not more than three valves located in the compressor room in the pumping station. This arrangement insures simplicity and furnishes elasticity to the source of the water supply and enables the different parts to be independent in their operation.

The actual lift of water from the wells varies greatly and has ranged from only a few feet to as much as 38 feet. The design of the water columns was based upon a predetermined flow of water and a lift of 22 feet, or a submergence of 69 percent based on 70.5 feet effective height; but as to which is the most efficient submergence for the installation has never been conclusively determined by test. The year previous to August, 1925, was the driest on record, locally, and it was during this period that the plant was operated at intervals with the maximum lift noted, or a submergence of only 46 percent, as compared to the calculated most efficient submergence of 67 percent.

The low water stage affects the capacity of wells very greatly, and also air requirements, as will be seen in *Figure* 4, and reduces the efficiency to about one-half of the best determined to date. See "Air Lift Water Installation Efficiencies," to follow. The drawdown in wells, or the difference between the static water level and the operating level, varies considerably, but probably has never been more than six feet.

Air System

Authorities agree that the installation inside of the well of an air lift water system is the most important feature of an air lift problem as its proportioning affects the efficiency of the whole plant to a greater extent than anything else. The mechanical and volumetric efficiencies of the compressor units are well known and controlled, and the air transmission problem is not difficult of solution, but the well installation requires careful study. All wells are not alike, even when located at comparatively small distances apart and in seemingly identical formations; and do not act alike; and a poorly designed installation in one well of a series, when improperly operated, will materially affect the overall efficiencies of the entire plant. Although the pipe sizes of the water columns within all wells are readjusted at time of final test of the whole plant, two wells with objectionable characteristics are still to be found in this water development, and to keep them in proper balance and operate them economically with the other wells is difficult.

In each of the eleven wells an air lift pump with a probable efficiency of 45 percent under average operating conditions is installed to raise the water into the reservoir referred to above. Such efficiency has been based upon the electrical input to the motor driving the compressor, and the following assumptions:

Motor efficiency, 90 percent.

Belt drive efficiency, 97 percent.

Compressor mechanical efficiency, 91 percent.

Transmission losses, 5 percent.

This efficiency although satisfactory for an air lift pump may not seem high to one familiar with efficiencies of pumps where such efficiencies are ob-

tained under ideal test conditions, but will probably not be far off from the efficiency of the average vertical, high speed, deep well, centrifugal pump. Actual tests made locally justify this statement; and as there are no moving or appreciable wearing parts to an air lift, it is reasonable to assume that the air lift efficiency noted will be maintained. However, there are other economies possessed by the air lift pump upon which the final decision as to its installation in preference to the centrifugal pump was reached, e. g., certainty of operation, and elimination of maintenance and repairs, all of which are referred to under heading "Air lift vs. high speed, deep well, centrifugal pump."

The air lift pump includes principally the foot piece, a water column extending to the point of discharge at top of well, and a pipe line from the air supply to the foot piece, a typical installation in one of the wells being as shown in *Figure* 3.

The foot piece consists essentially of an inner water discharge tube surrounded by an annular air chamber with a connection to the main air supply pipe lines. The wall of the inner discharge tube has one line of the holes near bottom and two lines of nozzles higher up, all three of which admit the compressed air into the column of water.

The water columns in all wells previous to April, 1925, were uniformly 65 feet in length and the elevation of their discharge is the same for all the wells. Such adopted length was based upon the average ground water level conditions throughout the year as determined by monthly readings made for the six years preceding the time of the installation. In April and May, 1925, which was during an unusual drougth period of a year's duration, with its unprecedented low water level, a 10-foot extension was made to the water column so as to improve the submergence, which had decreased to 46 percent, and to increase the flow of water. Above the foot piece is a tapered water column, increasing in diameter from the foot piece to the point of discharge at top of well. The water column is surmounted by an umbrella-shaped deflector. The tapered pipe is made up of standard pipe and casing of three or four different diameters in the 65-foot length, the pipe length being united by means of special long increasers.

The proper design of the pipe of the water column has admittedly not been realized in the installations because of the lack of sufficient sizes of commercial pipe to maintain a constant velocity of the rising column of combined water and air. To satisfy computations, authorities agree that the most efficient pipe should be tapered. To approach

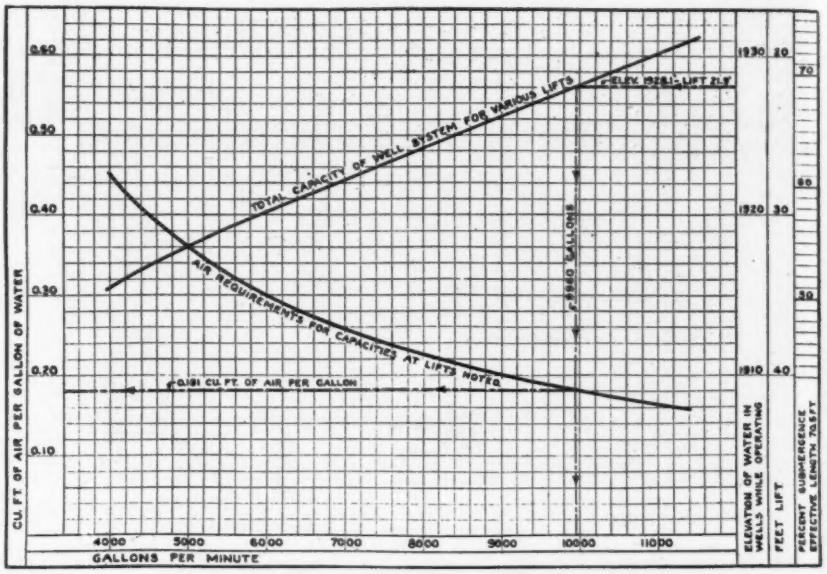


Fig. 4.—Curves showing capacities of wells for various lifts, and corresponding air requirements. Amounts of water for respective lifts based on tests made monthly since May, 1919, to date. Air used was same for all tests, or 1,800 cubic feet per minute net

this ideal condition by using commercial sizes of pipes of the usual stock lengths the velocities in the water column must necessarily vary from one end of the pipe to the other. The desired velocity of the combined air and water in the rising column was 10 feet per second but, due to conditions noted, varied from 8.5 to 11.5 feet per second, when assuming 1,200 gallons of water per minute as the capacity of the well. The gradual increase in velocity from 10 feet per second to the maximum of 11.2 feet in one pipe length does not make so much difference because friction in the pipe line is the only part affected, but the rapid drop in the velocity where the pipe diameters increase is serious because the sudden expansion at these points allows the air to separate from the water and slip by, thereby reducing its effectiveness. This is especially true at the connection between the 9-inch and 10-inch pipes where the velocity decreases from 11.2 feet per second to 8.7 feet per second in a vertical distance of less than 2 feet, or in the very short period of less than one-fifth of a second of time.

The plant supplying compressed air to the wells is located in the pumping station and is 1,400 feet from the farthest well. Two compressors of 2,168 cubic feet piston displacement each and one of 688 cubic feet piston displacement constitute the equipment. The two large compressors have variable speed motors so that the quantity of air produced can be proportioned according to economic requirements. Theoretically a variable speed for the compressors is a valuable feature in an installation where the water level in wells is so irregular, as the proper distribution of air to an air lift pump is one of the most important factors in obtaining low costs. Such considerations may be worth while with a steam-driven compressor but the air lift economies obtainable by such air volume control are probably offset by the power input into the motor circuit which, due to the grid resistances, is practically constant for all speeds.

Reservoir

As stated under "Well System" the water from the wells is delivered to a reservoir before same is handled by the plunger pumps in the pumping plant. The gross capacity of this reservoir is 323,000 gallons, or only about one-half hour's supply for the plunger pumps when same are operating at their maximum. The reservoir is not intended for storage but is merely a junction chamber insuring elasticity between the three pipe lines from the water supply and the two suction pipes to the plunger pumps. The reservoir is, however, of sufficient size to afford opportunity for sedimentation and is so located as to secure a gravity head upon the suction end of the plunger pumps, instead of the suction lift as formerly with the open well system. This change in suction conditions effected a saving of nearly 10 percent power requirements of the plunger pumps; an improvement in their volumetric efficiencies; and lessened repairs.

The reservoir is divided into two equal compartments so as to facilitate cleaning, repairs, etc. A Cipolletti weir constructed at the intake of the reservoir is equipped for instantaneous reading

of the quantity of water delivered by the well system.

Air Lift vs. High Speed, Deep Well Centrifugal Pumps

Previous to the construction of the air lift water installation two 18-inch diameter wells were bored 100 feet deep and in each of them was installed a popular make of motor-driven, high-speed, deep-well centrifugal pump of 500 g. p. m. capacity. The water from these installations was intended for domestic and power house use principally; and for extended periods, their operations were practically continuous. These pumps proved a constant source of expense and worry and one centrifugal pump was removed and in its place was installed an air lift pump with more favorable operating results. Tests were made upon the remaining centrifugal pump in one well and the air lift pump in the other, with the following results:

Overall efficiency, centrifugal pump, based on brake horsepower, 25 percent.

Overall efficiency air lift pump, 33.6 percent.

These tests were made preliminary to making a final decision regarding kind of pumping units to be adopted for the larger plant.

During one year's practically continuous operation of the test air lift pump installation the maintenance and repair charges were nominal, a statement which could not be made concerning the centrifugal pump. The maintenance and repair charge on an air lift pump should approximate that of an ordinary steel pipe line. The air lift pumps have been in operation for seven years and to date no repairs have been found necessary within the wells themselves, and the compressor repairs have proven of nominal consideration.

The verticality of the well is a factor which greatly influences the successful operation of any centrifugal pumps which possess long vertical shafts, as was proven locally, where the wells were neither vertical nor straight. All of the local wells were sunk in a formation varying from silt to boulders, and it seemed practically impossible to drill a plumb hole, one or two wells inclining as much as one and one-half feet in their total depth. The air lift can be operated wherever a pipe line can be installed.

Air Lift Water Installation Efficiencies

The overall mechanical efficiencies of the air lift water installation which does not include the plunger pumps, have been determined for several submergences under actual operating conditions but the range of such tests has not been sufficiently extensive to plot a satisfactory curve and thus show clearly the variations in efficiencies under the different conditions of operations. As will be noticed in *Figure* 4, the curve for well capacities, which is based on monthly readings extending over a period of six years, the capacity of the well system varies with the water levels in the wells, the air supply being constant, or the output of one compressor with a piston displacement capacity of 2,168 cubic feet per minute. If sufficient data were available to plot an efficiency curve, it should prove interesting in that indications are that it would show a certain submergence at which the maximum plant efficiency could be realized.

The overall efficiencies of the air lift water installation, based on the electrical input to motor, approximates 30 percent for average operating conditions. The highest overall efficiency determined by test was 34 percent with 67 percent submergence and one 2,168 cubic foot compressor supplying the air. In October, 1919, during the official test, with a submergence of 69 percent, an efficiency of 31.8 percent was realized, the air supply being the same. In a test made at the same time with only one-half of the air supply, and a submergence of 71 percent, the efficiency was 31.7 percent. In November, 1923, with a submergence of 65 percent the efficiency was 26.3 percent. During the period of unprecedented low water conditions in the years 1924 and 1925, it was found necessary to use two compressors when water demands exceeded 4,000 gallons per minute. On November 30, 1924, with two such compressors operating during test, and delivering a total of 7,000 gallons per minute, with a submergence of 46 percent, the overall efficiency dropped to 17.5 percent. The above are a few representative tests made with the water columns of the air lift pump, 65 feet long, as per *Figure* 3.

As previously mentioned, a 10-foot extension to the water column in all wells was added in April and May, 1925. After such revisions were completed a test was made on May 5, 1925, with the average operating water level 2.5 feet higher than on November 30, 1924; and with a submergence of 56 percent, the same two compressors as used on November 30, 1924, delivered 8,200 gallons per minute with a plant overall efficiency of 18.6 percent. On February 24, 1926, with the same water column as used on May 5, 1925, and a submergence of 71 percent, one compressor only, delivered 9,700 gallons per minute, and the overall plant efficiency realized was 25.5 percent.

As previously stated under "Air System," the probable efficiency of the air lift pump proper, which includes the entire installation within a well, is 45 percent with a lift of 21 feet. This efficiency will vary with the lift, and with the velocity of flow. From results of the official tests, made with different quantities of air, all other conditions being the same, except that the power consumption was determined from compressor indicator cards, it seemed that, with the lift of 21 feet, the efficiency of the air lift pump increased as the velocity of flow in the water column decreased. A study of this situation would indicate, that to obtain the best results with low lifts it is advisable to have as low velocities as possible to maintain a steady flow. A reasonable explanation of this would seem to be the following: *Figure* 5 shows that the total volume of air to wells being the same in all cases, the capacities of the well system vary with the lifts, the lower the lifts the greater the capacities. To obtain the higher capacities it is therefore necessary to impart higher velocities to the flowing water. These higher velocities cause the water to hit the deflector at the well discharge with such force that, were the deflectors removed, the water would gush to an unnecessary height. The excess energy thus represented is entirely lost. Another probable cause of some of the losses within the wells themselves when operating at high capacities is the size of well and the equipment installed therein. By referring to *Figure* 3 you will note that the foot piece, is installed below the water bearing formation, and, therefore, all water flows downward to reach the point of entry into the foot piece. The well casing is 16 inches in diameter and the largest part of the foot piece of the air lift pump occupies about 45 percent of the cross sectional area of the well. With 1,200 gallons of water per minute flowing, or the approximate maximum flow, the downward velocity through the net section of the well at the bottom of the foot piece is 3.4 feet per second and the upward velocity inside the foot piece is 5 feet per second. With 800 g. p. m. this downward velocity becomes 2.1. This down-draft and change in direction of flow produces the equivalent of an additional lift upon which energy has to be expended; and if the lift thus produced varies as some power of the velocity greater than unity, the losses thus represented must effect the efficiencies very appreciably. A larger diameter well would reduce this loss somewhat.

One condition has shown up in the wells which was not anticipated, but which materially affects the efficiency of the air lift pump, and that is the formation of scale, and "carbuncles," of a mineral salt composition on the inside surface of the iron pipe of the water column. Among other things this formation increases friction and reduces pipe

areas, and as a result of the latter, the velocity is increased.

Maintaining the wells in balance is a factor which affects economic results. It is the constant endeavor to maintain a uniform operating lift for all the wells of the series. Some consideration has recently been given to the automatic control of uniformity of lifts in the 11 wells, and valves for such purpose have been installed recently, but the results attained to date are not conclusive.

PRIMARY PUMPING PLANT

The pumping plant proper, which delivers the water to the industries and the townsite at Hayden, was begun in the year 1910, as part of the original open well system installation, and except for the compressor room extension for the air lift system compressors and a few minor changes, is the same as then constructed. The floor of the building is located about 17 feet below ground level, which was at the time of construction, five feet below the static water level. This elevation was adopted so as to obtain satisfactory suction conditions for the plunger pumps installed within the building.

The pumping units which deliver water for industrial use are independent of those which pump the domestic supply and for high pressure service.

Three motor-driven, 16x18-inch vertical quintuplex plunger pumps, with a rated capacity of 3,300 g. p. m. each, are used for delivering all water to the mill reservoir for industrial use, and two motor-driven 10x12-inch vertical triplex plunger pumps of a combined capacity of 1,400 gallons, pump water to the domestic reservoir for domestic and high pressure service.

FLOW-SHEET AT HAYDEN PLANT

(*Continued from page* 370)

This means of conveying material from one point in the plant to another has been used to advantage in the Hayden plant for over 10 years. In the case at hand, the distance from the point where the pulp enters the pipe line to the point where it is discharged is 165 feet horizontally and the loss in head between the two points is only 8 inches. An additional advantage of such an installation is that the pipe may be carried underground or rested upon any available supports, thus obviating the necessity of overhead supports that are necessary with the ordinary launder installations.

By the above division of the tube mill product into two parts the flotation plant is separated into two independent units, each taking the feed from four sections of the mill. The flotation equipment itself consists of two double rows of roughers, cleaners and recleaners for each mill section.

Each double row of roughers consists of two parallel strings of six cells each, with a common froth launder between; each cell being 15 feet long overall, 30 inches wide and 24 inches deep at the shallow end; the slope of the bottom being one-half inch to the foot. Each double row of cleaners consists of two strings of two cells each, and each double row of recleaners consists of two strings of one cell each; all of the same dimensions as the rougher cell.

The feed to the flotation plant, discharging as it does from the vertical pipe, is very simply and effectively divided in equal amounts between the different rows. The feed enters the head end of the roughers, which produce a rougher concentrate and the final mill reject tailings. The rougher concentrates are pumped to the head of the cleaners. The cleaner tailings are returned by gravity to the head of the fourth cell of the roughers. The cleaner concentrate is fed into the head end of the recleaner cells, which produce the final flotation concentrate and a tailing, which is returned to the head of the cleaner cells via the rougher concentrate pump, after flowing down the rougher concentrate launder and providing the necessary flush water to keep same cleared.

Except for a spray on the cleaner concentrates, immediately ahead of the recleaner cells, no water, other than that contained in the original feed, is used in the flotation operation.

The reagents used at the present time are xanthate and a frothing oil. The xanthate is added in the form of a 10 percent solution to the overflow of the tube mill circuit drag classifiers. The oil is added immediately ahead of the rougher cells.

All sampling is electrically controlled. The headings, tailings and concentrate streams are cut approximately every six minutes. In the carrying out of test runs it is possible to conduct the operations simultaneously so that the old practice of relying upon consecutive runs, for the determination of the value of any particular reagent or flow-sheet, is entirely dispensed with.

The dewatering department is located outside of the main concentrator building. The gravity concentrates are removed from the settling bins by means of a 4-ton Gantry crane, which dumps directly into 80-ton capacity concentrate cars. The flotation concentrates are handled in the filter plant, which consists of one 40-foot Dorr thickener, two 75-foot Dorr thickeners, one 14-foot Portland filter, and three 12-foot Oliver filters. This plant is so located that the filters discharge directly into 80-ton capacity concentrate cars. The water from the settling bin and filter plant operations is the only reclaimed water used in the plant; this because of the fact that the original water is plentiful and relatively easy to obtain.

The source of the water supply is about 1 mile from the mill, and the difference in head between the pump station and the mill is 250 feet. A description of the pump plant and its operation is given in another article.

CHLORIDIZING ROASTING AND BRINE LEACHING OF ORES

IN ITS general study of chloridizing, roasting and brine leaching of ores, the Bureau of Mines, at its Intermountain Experiment Station, Salt Lake City, Utah, will, during the coming year, concentrate on the obtaining of cheap hydrochloric acid and calcium chloride, which are needed for controlling the brine circuit. The purpose of this study is to work out a process for the treatment of silver precipitate which is contaminated with copper and arsenic, and to encourage, in every way, the saving of lead which is being run to waste. Work on the precipitator which successfully utilized sponge iron as a precipitant during the past year will be continued, and the use of sponge iron as a precipitant encouraged. Work on low-grade oxidized siliceous ores was continued during the past year, and it was found that the addition of ferric salts to the brine solution increased the recovery of both silver and lead, and that under proper conditions electrolytic precipitation of the lead was feasible.

ABNORMALITY IN CASE CARBURIZED STEELS

The object of an investigation being conducted by the Bureau of Mines is to determine the cause of and means of controlling the varying carburizing and hardening characteristics of steels. The work will be carried on in cooperation with the Bureau of Standards. This is a new problem for the Bureau of Mines, although the Bureau of Standards has been working on it from the testing end. It was undertaken at the request of the steel industry and will be attacked from the standpoint of production.

The Bureau of Mines is conducting an investigation with the object of finding the causes for and methods of eliminating mechanical inclusions of foreign substances in steels. This is a new problem and is one phase of the general problem of the "physical chemistry of steel making" which the bureau proposes to study.

LEGISLATIVE REVIEW

Congress Activity Marked As Session Draws To Close—Mining Proposals Meet Favorable Action—Coal Legislation Considered—Silver Purchase Bill Held Up—Postal Survey Bill Passes Senate—Bills May Be Caught In Legislative Jam In Closing Days

UNUSUAL activity is marking these spring days in Congress. Imbued with the hope of early adjournment both the House and Senate are bending their energies toward disposing of the most pressing of the legislative proposals.

The administration's legislative program is making rapid progress toward enactment. Some measures, however, may have to go over until the December session. The present session has been outstanding from the fact that both House and Senate have with almost clock-work precision taken up and disposed of some of the most noteworthy national measures. Extreme partisan spirit has been lacking and measures have been acted on from a broad national viewpoint.

Rarely does a session of Congress act on all major problems and the end of this session may witness another legislative jam in the closing days which will result in the tie-up of some important legislation, forcing it to go over until the next session. To some of these bills objection has been raised either in committee or on the floor, resulting in the measures being held up. In other cases, lack of time or urgent reasons for the legislation may result in postponement of its consideration.

Mining legislation is occupying considerable attention. The Forest Service bill to restrict mining locations and development in national forests is still in a nebulous condition as no member of either House has yet introduced it. To all intents and purposes it may be considered dead. It is conceded that if the proposal is to be given any consideration it will have to be materially revamped to meet the practically unanimous opposition of mining interests. This Congress has been decidedly slow in pressing legislation which meets material opposition from the industry affected, especially in the case of the mining industry which is regarded in the light of a great national asset not to be tampered with or unduly restricted.

Legislation authorizing settlement of war mineral claims on account of losses in connection with the lease or purchase of property and interest on borrowed money is before the Senate for action on report of its mines and mining committee.

Silver Bill

The outlook for favorable action on the bill for the purchase at $1 per ounce of fourteen million ounces of silver is not bright. This bill has been reached by the Senate twice in its consideration of bills on the calendar, but has been sidetracked by an objection.

Prospecting permits and leases for sulphur in Louisiana have been authorized in a bill passed by both Houses, and the Senate has passed a bill looking to potash development. It authorizes appropriations of $550,000 for each of the next five years by the Geological Survey and Department of Agriculture of potash resources and means for their recovery.

The House Committee on Mines and Mining has given hearings on bills to establish mine rescue stations in Kentucky, and has considered the general problem of additional safety in mines to check recurring mine disasters. It is likely to recommend at the next session increased appropriations for the work of the Bureau of Mines in promoting mine safety.

A law has been passed by Congress and approved by the President authorizing a two-year extension of oil and gas prospecting permits in cases where the holders have been unable to comply with the requirement as to drilling operations. The law also permits further explorations under the permits. A bill authorizing mining leases on Indian agency and school lands has also been passed.

Coal Hearings

Congress has definitely tackled the coal problem, the House Committee on Interstate Commerce having instituted hearings with a view of drafting legislation to assure the public an adequate supply of coal at reasonable prices.

The bill for adjustment of railroad labor disputes through regional and other boards of mediation, replacing the present Federal Railroad Labor Board may be lost in the final jam of the session. It has already passed the House but the Senate has been unable, on account of pressure of other measures, to consider the bill.

Safety in industry is proposed in a measure introduced by Senator Shortridge, Republican, California, who suggests the creation of a safety division in the Department of Labor to study safety proposals to be applied to industry.

The only general investigation being conducted by Congress affecting industry is the inquiry of the Senate committee into the operation of the flexible tariff provision.

The following is a review of the action of Congress on pending bills:

War Minerals

S. 3641. Introduced by Mr. Oddie (Rep., Nev.). Reported by the Committee on Mines and Mining. This bill amends the war minerals relief act by authorizing the payment of claims for losses in connection with the purchase or lease of property and for interest paid or due on borrowed capital. It also provides for appeals from decisions of the Interior Department in war mineral cases to the Court of Claims and that payments shall not be reviewed by the Comptroller General. An amendment by Mr. Phipps (Rep., Colo.), limits attorneys fees on claims to $1,000 or 10 percent in awards of $10,000 or more.

S. 3186. Introduced by Mr. Ransdell (Dem., La.). Passed by the Senate and House. This bill authorizes prospecting permits and leases for sulphur on public lands in Louisiana. The bill originally applied to all parts of the country, but on objection of Senator King (Dem., Utah), to the leasing system, it was amended to apply only to Louisiana. The area which may be taken under a prospecting permit is 640 acres. If the permittee discovers sulphur he would be entitled to a lease at a royalty of 5 percent of the quantity or gross value of the output.

H. R. 9725. Introduced by Mr. Lazaro (Dem., La.). Reported by the Committee on Public Lands. This is similar to the foregoing.

H. R. 5243. Passed by the House. This is similar to the foregoing.

S. 3912. Introduced by Mr. Stanfield (Rep., Oreg.), by request. Referred to the Committee on Public Lands. This is similar to the foregoing.

Mine Rescue Stations

H. R. 10769. Introduced by Mr. Kirk (Rep., Ky.). Referred to the Committee on Mines and Mining. This bill proposes to establish a mine rescue station at Hazard, Ky.

H. R. 11213. Introduced by Mr. Kirk (Rep., Ky.). Referred to the Committee on Mines and Mining. This bill es-

tablishes a mine rescue station at Pikeville, Ky.

H. R. 10546. Introduced by Mr. Zihlman (Rep., Md.). Referred to the Committee on District of Columbia. This bill proposes the regulation by the District Commissioners of the sale in the District of Columbia of oil, gas, mining and other securities.

H. R. 10903. Introduced by Mr. Browne (Rep., Wis.). Referred to the Committee on Rivers and Harbors. This bill makes it unlawful to discharge into inland navigable waters any lime, bark, ballast, oil, acid, chemical substance, refuse or waste from any tannery, mill, manufacturing plant, shop or establishment.

S. Res. 113. Introduced by Mr. Frazier (Rep., N. Dak.). Referred to the Committee on Finance. This bill proposes an investigation of the cost of production and business methods of corporations engaged in the manufacture of metals.

Mining Leases

H. R. 9133. Introduced by Mr. Hayden (Dem., Ariz.). Reported by the Committee on Indian affairs. This bill authorizes oil and gas mining leases upon unallotted lands in executive order Indian reservations. The bill gives to the Indians all of the oil and gas royalties; authorizes the States to tax the production of oil and gas on such reservations, and extends relief to those who have sought to discover oil and gas under the leasing law. Minority views in opposition to the bill were made by Reps. Sproul (Rep., Kans.); Hudson (Rep., Mich.); Knutson (Rep., Minn.); Frear (Rep., Wis.), and Howard (Dem., Nebr.).

S. 2709. Introduced by Mr. Harreld (Rep., Okla.). Passed by the Senate. This bill authorizes the Interior Department to reduce the area to be annually offered for mining leases or to suspend new leases for two years in case of over-production or inadequate price of oil on the Osage Indian reservation, Okla.

Prospecting Permits

S. 2461. Enacted into law. This law authorizes a two-year extension of oil and gas prospecting permits in cases where the holders have been unable to comply with the law regarding drilling operations. It also permits further explorations for oil and gas.

H. R. 252. Passed by the House. This bill authorizes the Government to accept title to land for a post office at Donora, Pa., with a reservation of the minerals therein to the owner.

H. R. 8916. Passed by the House. This bill grants certain drilling sites in naval petroleum reserve No. 2 to Kern County, Calif., for park purposes.

S. J. Res. 76. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This bill proposes to give a 90-day preference right to a lease of 360 acres of land in the Red River oil region to those who previously made locations under the mining laws but were ruled out by the courts.

H. R. 6261. Enacted into law. This law authorizes the exportation from a State of timber lawfully cut on any national forest or on public lands in Alaska.

Potash Inquiry

S. 1821. Introduced by Mr. Sheppard (Dem., Tex.). Passed by the Senate. This bill authorizes appropriations of $550,000 for each of the next five years for investigations by the Geological Survey and Department of Agriculture of potash resources and improved methods for their recovery.

Land Grants

S. 3977. Introduced by Mr. Jones (Dem., N. Mex.). Referred to the Committee on Public Lands. This bill provides that in the adjustment of railroad land grants, a settler who may have purchased or entered such lands under existing law, may surrender them and receive non-mineral lands. The bill provides that the word "mineral" shall not include iron and coal where lands released under this act were granted by an act of Congress which authorizes the grantee to take iron and coal lands under the grant.

H. R. 10976. Introduced by Mr. Leavitt (Rep., Mont.). Referred to the Committee on Indian Affiairs. This bill authorizes mining leases on lands of the Fort Peck Indian Reservation, Mont., upon consent of the Indians.

H. R. 10980. Introduced by Mr. Winter (Rep., Wyo.). Referred to the Committee on Public Lands. This bill authorizes oil and gas leases in Carbon County, Wyo., at 12½ percent royalty to M. B. Woolery, D. S. Wageley, D. N. Kerr, A. J. Denny, M. G. Duncan, M. L. Lundy, and C. L. Smith, upon their surrender of rights under the placer mining law.

H. R. 7752. Passed by the House and Senate. This bill authorizes mining leases on Indian agency and school lands.

H. R. 7372. Passed by the House and reported by the Senate Public Lands Committee. This bill amends the leasing law by limiting acreage to be held thereunder as follows: for coal, phosphate, or sodium, 2,560 acres in any one State; oil or gas, 7,680 acres in any one State, and not more than 2,560 acres in a geologic structure of the same producing oil or gas field.

S. 2339. Introduced by Mr. Stanfield (Rep., Oreg.). Reported by the Committee on Public Lands. This is similar to the foregoing.

Indian Lands

H. R. 8313. Passed by the House. This bill allots lands in Montana to the Crow Indians and authorizes leases for mining purposes thereon.

H. R. 9558. Passed by the House. This bill allots land to Indians in the Tongue River or Northern Cheyenne Indian Reservation, Mont. It authorizes a survey of the lands by the Geological Survey to determine their mineral character, and stipulates that 50 years from approval of this law, the minerals shall become the property of the allottees or their heirs.

S. 3810. Introduced by Mr. Wheeler (Dem., Mont.). Referred to the Committee on Indian Affairs. This bill authorizes the Fort Peck Indians in Montana to lease their lands for mining purposes.

Alaskan Roads

H. J. Res. 73. Reported by the Committee on Territories. This bill authorizes an appropriation of $750,000 for a system of roads from Nome, to Shelton, Kugruk River, and Keewalik, Alaska. These roads would reach mining and coal districts. Representative Rankin (Dem., Miss.), filed a minority report against the bill, saying it will benefit only a few persons who desire to prospect for gold. "I am not willing to spend money to help a few gold hunters extend their operations for personal gain," he says.

H. R. 9037. Passed by the House and reported by the Senate Public Lands Committee. This bill validates certain land entries, including the mineral entry of John H. Haggett in the Portland, Oreg., district.

S. 2716. Introduced by Mr. Harreld (Rep., Okla.), by request. Reported by the Indian Committee. This bill authorizes the Interior Department to collect a 3 percent fee from Indian royalties on their mining lands to be used in development and operation of leases.

S. Con. Res. 9. Introduced by Mr. Harrison (Dem., Miss.). This bill provides for a commission of two Senators and two Representatives to investigate conditions in the Philippine Islands, including possibilities for development of natural resources.

Mineral Resources

S. 3901. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Public Lands. This bill proposes to cede unreserved public lands to the States.

S. 2584. Introduced by Mr. Stanfield (Rep., Oreg.). Reported by the Committee on Public Lands. This bill establishes grazing districts on public lands in the west, but stipulates that

the use of these lands for grazing shall be subordinated to the development of their mineral resources.

H. R. 10607. Introduced by Mr. Haugen (Rep., Iowa.). Referred to the Committee on Agriculture. This is similar to the foregoing.

S. 3698. Introduced by Mr. Norris (Rep., Nebr.), by request. Referred to the Committee on Agriculture. This is similar to the foregoing.

Alaskan Mine Claims

H. R. 6572. Reported by the Committee on Mines and Mining. This bill amends the mining law of Alaska by permitting two mining claims to be located in each of the recording districts in Alaska.

H. R. 10276. Introduced by Mr. Kiess (Rep., Pa.). Reported by the Committee on Insular Affairs. This bill provides a form of government for the Virgin Islands and stipulates that the minerals shall be administered for the benefit of the people.

H. R. 10865. Introduced by Mr. Kiess (Rep., Pa.). .Reported by the Committee on Insular Affairs. This is similar to the foregoing.

Coinage Bills

H. R. 8306. Passed by the House. This bill authorizes the coinage of six million 50-cent pieces in memory of those who went over the Oregon trail.

H. R. 8267. Reported by the Coinage Committee. This bill proposes to coin copper cent pieces in memory of Henry W. Longfellow.

S. 3693. Introduced by Mr. Jones (Dem., N. Mex.). Referred to the Banking Committee. This bill proposes to coin 5,000,000 50-cent pieces in memory of the patriotism of American women in wars.

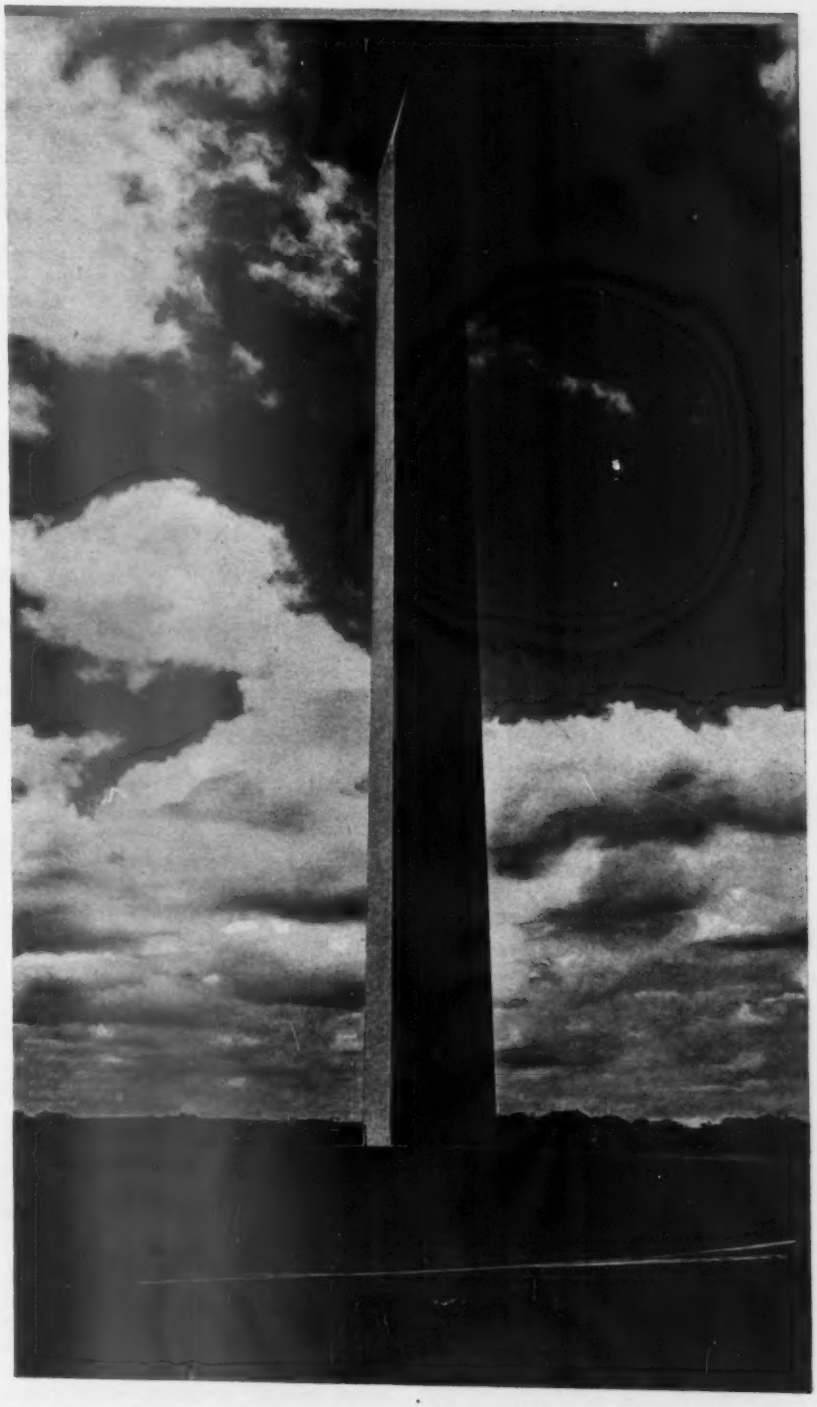
Coal Standards

H. R. 10824. Introduced by Mr. Kelly (Rep., Pa.). Referred to the Committee on Interstate Commerce. This bill prescribes standards for the shipment of various sizes of anthracite.

H. Res. 194. Introduced by Mr. Fish (Rep., N. Y.). Referred to the Committee on Interstate Commerce. This resolution requested the Secretary of Commerce for information as to anthracite prices prior and subsequent to the last two anthracite strikes, and whether anthracite operators are profiteering. It is also asked the Secretary of Commerce whether he had recommended or was considering coal legislation. The Secretary of Commerce replied that the information was not available and that he had made no recommendation as to coal legislation.

Coal Emergency

H. R. 11326. Introduced by Mr. Kelly (Rep., Pa.). Referred to the Interstate Commerce Committee. This bill authorizes the President to deal with an emergency which may arise in the coal industry through interruption of mining. Under it he could appoint temporary boards to investigate and report on the situation, and also designate a Fuel Administrator to supervise the distribution, allotment, sale and marketing of coal.



H. R. 10503. Introduced by Mr. Miller (Rep., Wash.). Reported by the Naval Committee. This bill provides for the conversion of six coal burning battleships to oil burners.

S. Res. 176. Introduced by Mr. Gooding (Rep., Idaho). Referred to the Committee on Interstate Commerce. This resolution calls for an investigation by a committee of seven Senators of the receivership of the Chicago, Milwaukee and St. Paul railroad. The resolution says a receiver for this railroad was appointed on petition of the Binkley Coal Company, a creditor. The resolution says the railroad abandoned coal properties to which it had constructed lines, and over which it had transported coal.

IMPORTANT BILLS REVIEWED IN THIS ISSUE

MINING—
- S. 3641: Oddie (Rep., Nev.). War Mineral Claims.
- S. 3186: Ransdell (Dem., La.). Sulphur permits and leases.
- H. R. 10903: Browne (Rep., Wis.). Stream pollution.
- H. R. 9133: Hayden (Dem., Ariz.). Mining Leases.
- S. 2709: Harreld (Rep., Okla.). Oil Lease Suspension.
- S. 2461: Enacted into law. Oil Permit Extension.
- S. 1821: Sheppard (Dem., Tex.). Potash Survey.
- H. J. Res. 73: Reported by Committee. Alaskan Roads.
- S. 3901: Cameron (Rep., Ariz.). Land to States.
- H. R. 6572: Sutherland (Rep., Alaska). Mine Claims.

COAL—
- H. R. 10824: Kelly (Rep., Pa.). Shipments by Grades.
- H. R. 11326: Kelly (Rep., Pa.). Emergency Control.
- H. Res. 194: Fish (Rep., N. Y.). Price Inquiry.

TRANSPORTATION—
- S. 3721: Gooding (Rep., Idaho). Compensatory Rates.
- S. 575: Gooding (Rep., Idaho). Long and Short Haul Rates.
- S. 3840: Cummins (Rep., Iowa). Railroad Consolidations.
- H. R. 9463: Parker (Rep., N. Y.). Railroad Labor Disputes.
- H. J. Res. 214: Appleby (Rep., N. J.). Electric Railroad.

INDUSTRIAL—
- H. R. 10982: Morin (Rep., Pa.). War Conscription.
- S. 2320: Passed by Senate. Safeguard Acid Distribution.
- S. Res. 177: Sheppard (Dem., Tex.). Wage Inquiry.
- S. Res. 203: Walsh (Dem., Mont.). Industrial Merger Inquiry.
- S. 3983: Shortridge (Rep., Calif.). Safety Division.

Alaskan Railroads

H. R. 6573. Passed by the House and Senate. This bill extends the time within which the Alaska Anthracite Railroad shall complete its lines in that territory.

S. 3721. Introduced by Mr. Gooding (Rep., Idaho). Referred to the Committee on Interstate Commerce. This bill defines as "reasonably compensatory" railroad rates which will pay the cost of service, interest on bonds, and dividends.

S. 575. Introduced by Mr. Gooding (Rep., Idaho). Defeated by the Senate. This is the so-called long and short haul bill and proposed to prohibit higher rates for shorter hauls than are charged for longer hauls where water competition is involved.

S. 3720. Introduced by Mr. Gooding (Rep., Idaho). Referred to the Committee on Interstate Commerce. This is similar to the foregoing, except that it would only apply to rates affected by competition through the Panama Canal.

Railroad Consolidations

S. 3840. Introduced by Mr. Cummins (Rep., Iowa). Reported by the Committee on Interstate Commerce. This bill provides for the consolidation of railroads into large systems.

S. 750. Introduced by Mr. Mayfield (Dem., Tex.). Reported by the Committee on Interstate Commerce. This bill would require railroads to secure permission from the Interstate Commerce Commission to construct new lines, and also permission from the States to abandon lines in a State.

Railroad Labor

H. R. 9463. Passed by the House and reported by the Senate Committee on Interstate Commerce. This bill authorizes regional and other boards to settle railroad labor disputes, and abolishes the Railroad Labor Board.

H. R. 10930. Introduced by Mr. McLaughlin (Rep., Nebr.). Referred to the Committee on Interstate Commerce. This bill authorizes interchangeable railroad mileage books at 20 percent less than the regular rate.

S. 3286. Passed by the Senate. This bill authorizes reduced freight rates in case of earthquake, flood, fire, famine, drought, epidemic, pestilence or other disaster.

Electric Railroad

H. P. Res. 214. Introduced by Mr. Appleby (Rep., N. J.). Referred to the Committee on Interstate Commerce. This resolution proposes a survey for a great eastern electric freight railroad between the Great Lakes and New York through northern Pennsylvania and New Jersey, with terminals at Erie and New York. The object is to reduce transportation costs. The resolution points out that winter conditions would render valueless for four months in the year the proposed St. Lawrence River or the Great Lakes-Hudson ship canals. The proposed railroad would have six tracks and its cost would be met by a 20-year bond issue, the railroad to be built and operated by the Government at cost. Electric power for the railroad could be produced from water along the route. The bill appropriates $150,000 for the survey, on which a report will be made next December. The War Department has reported adversely on the proposed Great Lakes-Hudson waterway.

S. J. Res. 79. Introduced by Mr. Frazier (Rep., N. D.). Referred to the Committee on Interstate Commerce. This is similar to the foregoing.

Defense Council

H. R. 10982 and H. R. 10985. Introduced by Mr. Morin (Rep., Pa.). Referred to the Committee on Military Affairs. These bills propose to create a council of national defense, composed of Government officers, who would investigate and report on the status of essential key industries, the situation regarding essential raw materials of foreign origin, etc. In an emergency the President would have authority to use man power, industries, finances, transportation and other national resources essential to the national defense.

S. 2320. Passed by the Senate. This bill is designed to safeguard the distribution and sale of dangerous caustic or corrosive acid and alkalies.

H. R. 10823. Introduced by Mr. Griest (Rep., Pa.). Reported by the Committee on Interstate Commerce. This is similar to the foregoing.

Wage Inquiry

S. Res. 177. Introduced by Mr. Sheppard (Dem., Tex.). Referred to the Committee on Labor. This bill authorizes a committee of seven Senators to investigate typical mills in the aluminum

and steel industries as to wages and working conditions, reporting December 31.

H. R. 7732. Enacted into law. This law amends a prior law to carry out a wage increase of the National War Labor Board in favor of employes of the Bethlehem Steel Company. It provides that the increased wages authorized by the board shall be paid to those who entered the employ of the company after August 1, 1918. It also provides for payment of the award by the War Department at Bethlehem, Pa., and for approval of the payments by the General Accounting Office.

INDUSTRIAL MERGERS

S. Res. 203. Introduced by Mr. Walsh (Dem., Mont.). Referred to the Committee on Interstate Commerce. This resolution calls for an investigation and report by the Federal Trade Commission on corporations and combinations alleged to have been organized and operated in violation of the anti-trust law during the past four years. The merger of the duPont Company is named among recent industrial consolidations. The resolution says the precedent set by the decision of the Supreme Court in the Steel Corporation case seems to have been misconstrued in view of the more recent decision in the Lehigh Valley Railroad case, in which a smaller control of the industry affected was held to be in violation of the law. The resolution says the intent of Congress in passing the anti-trust law was to prohibit all combinations of competitors that would lessen competition, create monopoly and increase prices, whether by acquisition of stock or plants.

INDUSTRIAL SAFETY

S. 3983. Introduced by Mr. Shortridge (Rep., Calif.). Referred to the Committee on Labor. This bill creates a Division of Safety in the Bureau of Labor Statistics of the Department of Labor. This division would collect statistics of industrial accidents in all lines of employment; collate and analyze statistics of accidents with special reference to their causes, effects and occupational distribution; make general and special studies and investigations of labor safety plans and devices and of their need and adaptation as relates to different classes of machinery; processes of production and undertakings in which labor is employed; and to study all phases of occupational hazards and diseases and their prevention. The division would provide a museum to exhibit approved devices for safeguarding machinery, protecting employes from injury, lessening dangerous conditions in industrial enterprises and methods of lessening, preventing and controlling industrial diseases. The bill also provides for a laboratory in the division for examination and test of the efficiency of types of guards or other devices for the protection of machinery calculated to safeguard employes or the public from injury or industrial disease.

H. R. 11059. Introduced by Mr. Frothingham (Rep., Mass.), by request. Referred to the Committee on Ways and Means. This bill proposes a duty of 100 percent on imported granite.

Burton Bunch

Recently appointed field secretary Southern Division, The American Mining Congress

S. 66. Introduced by Mr. Jones (Rep., Wash.). Reported by the Committee on Commerce. This bill establishes foreign trade zones in American ports.

S. Con. Res. 17. Introduced by Mr. Fish (Rep., N. Y.). Referred to the Committee on Foreign Affairs. This resolution requests the President to appoint a commission consisting of representatives of manufacturing, commercial, financial, agricultural, exporting, and importing interests of the United States and Government officials, to reopen trade relations with Russia.

EXPLOSIVES DISTRIBUTION

H. R. 10826. Introduced by Mr. Schneider (Rep., Wis.). Referred to the Committee on Agriculture. This bill appropriates $20,000,000 over a period of 10 years for the distribution of explosives by the Department of Agriculture to settlers for clearing and reclaiming cut-over forest lands.

H. R. 10904. Introduced by Mr. Browne (Rep., Wis.). Referred to the Committee on Agriculture. This bill appropriates $50,000 for experiments by the forest service of methods of disposal of waste materials of pulp and paper mills without polluting streams.

S. 3787. Introduced by Mr. Wadsworth (Rep., N. Y.). Referred to the Committee on District of Columbia. This bill proposes to incorporate the National Institute of Social Sciences. Among the incorporators are Daniel and Harry F. Guggenheim and Van H. Manning of New York, the latter of the American Petroleum Institute and formerly director of the Bureau of Mines.

H. Res. 180. Introduced by Mr. Thomas (Dem., Okla.). Referred to the Committee on Rules. This resolution authorizes a committee of seven members of the House to receive suggestions for changes in the form and operation of the Government.

COMMERCE PROMOTION

H. R. 3858. Passed by the House. This bill creates organic law for the work of the Bureau of Foreign and Domestic Commerce, which has heretofore been conducted under annual congressional appropriations.

H. R. 10864. Introduced by Mr. Garber (Rep., Okla.). Referred to the Committee on Flood Control. This bill authorizes the States to apply conserved waters to beneficial use.

S. 2516. Reported by the Senate Committee on Agriculture. This bill establishes a forest experiment station for Pennsylvania and neighboring States.

H. J. Res. 222. Introduced by Mr. Sabath (Dem., Ill.). Referred to the Committee on Expositions. This bill appropriates $5,000,000 for Government participation in a centennial celebration at Chicago in 1933.

H. R. 9690. Introduced by Mr. Butler (Rep., Pa.). Passed by the House. This bill authorizes a five-year naval aircraft construction program costing $85,000,000, of which $300,000 is for an experimental metal-clad airship.

CHILDREN TAUGHT FIRST-AID

The Division of Mine Inspection of the state of Washington is undertaking a campaign for the training in first-aid methods of the children of the miners of that state. Wives and other female relatives of the miners are also being instructed in first-aid. The First-Aid Manual of the United States Bureau of Mines is being used in giving this training. The purpose of this campaign, as stated by William R. Reese, chief mine inspector, is to inculcate safety in the minds of the children and at the same time prepare them to be able to administer first-aid to others who have been the unfortunate victims of an accident.

CONGRESS AND COAL INDUSTRY

(*Continued from page* 332)

fields was recommended by Mr. Jacobstein, who also suggested government operation of mines in an emergency it recommended by an emergency coal board, which he proposed.

In his analysis of the coal situation, Mr. Jacobstein said: "The deadlock in the anthracite industry is deeper than a conflict between capital and labor. It is fundamental in the industry itself. The deadlock hinges on the fact that one-fourth of anthracite is produced at high cost and no profit; 50 percent is mined at low cost and high profit, and the balance is mined at cost and profit. You cannot solve the coal problem until you decide the question of valuation of anthracite mines. The miners know the varying valuations which are set up and are not satisfied because they feel the profits of the companies are too high and that they should share in the prosperity of the industry."

Discussing the bituminous situation, Mr. Jacobstein said it was disorganized and had 15,000 mines and 200,000 miners more than are necessary. He feared there would be a strike next spring when the bituminous wage agreement expired. "If you do not pass legislation before March 31, 1927, there is likely to be a strike and it might be carried into non-union fields," he said. Declaration was also made by Mr. Jacobstein that the bituminous industry is backward in introducing mining machinery. He said coal mines are quasi or semi-public utilities subject to regulation by the government. He thought coal producers should get together with railroads and industrial users on plans to operate the industry on more economic lines. "To do nothing in the way of legislation would be to stick our heads in the sand," said Mr. Jacobstein. "The President does not believe in interfering with business, but he does recommend coal legislation. We should have a national coal mining policy."

"The shipper should attach to his bill of lading a certificate that the quality of anthracite complies with the standards set by the Bureau of Mines," said Representative Luce, in urging his bill on this subject. "The Bureau of Mines believes the time will come when it will be necessary to provide for analysis of coal and that sooner or later similar legislation will be necessary for bituminous."

Representative Wainwright said the coal commission report had been "toned down" and that it did not present a satisfactory solution of the coal problem. "Coal is as necessary as water and light and the public is entitled to an uninterrupted supply at fair prices," he said. "I oppose the creation of any more government agencies. The mining of coal is a semi-public duty similar to that of a soldier in the military service of his country."

Postponement of legislation until next winter was suggested by Representative Mead who thought the intervening time should be devoted by the House and Senate Committees, in cooperation with government agencies handling coal matters, to work out a plan of legislation affecting coal to assure constant supplies at fair prices. He thought the coal industry could be supervised satisfactorily by a coal council consisting of the Conciliation Service of the Department of Labor. "Legislation is necessary in order to bring about reforms in the coal industry," said Mr. Mead, in reply to a suggestion of Representative Merritt, Republican, Connecticut, a member of the committee, that Congress "drop the idea of legislation."

Representative Black suggested the creation of a corporation to be financed by the Government to operate mines and sell coal during an emergency. He said the Government had authority to take possession of private property for a national purpose, and cited a decision of a Utah court which had declared a private gold mining company to be a public utility with the power or eminent domain. Mr. Black contended that the Government could take over a private utility corporation if it ceased to function in the public interest. "The Government must be a working proposition," he said. "Congress should try to reach the situation by going in and working the mines, leaving the constitutionality of the act to be determined by the courts." Mr. Black said that constitutional objections should not be raised to measures designed to benefit the public, but that their constitutionality should be presumed, allowing the courts to pass on it. When he suggested that the act forbid the taking out of an injunction against the right of the corporation to operate mines, Representative Hoch, Republican, Kansas, a member of the committee, remarked: "Why not say the Supreme Court cannot decide that it is unconstitutional?"

"Don't wind this matter up with legal entanglements and red tape," urged Representative Boylan, who advocated placing authority with the President to handle an emergency through the Departments of Commerce and Labor, rather than under a new coal agency. "When an emergency arises, we must meet it and not look for precedents, but must establish them and blaze a new trail if there are none. When an enemy is at your door, you go after him. The situation may blow up next January and I urge that you do something to meet it. If your legislation is not constitutional, the people will, however, be able to get coal under it, and its constitutionality can be later determined."

Representative Fish created a mild sensation and aroused the committee when he declared that invisible influences were at work to prevent legislation. "There has never been any pressure on me to prevent legislation," sharply responded Representative Parker, Republican, New York, chairman of the committee. "I resent your statement," said Representative Nelson, Republican, Maine, a member of the committee, while Representative Merritt said he did not believe a lobby was operating against legislation. Representative Fish insisted, however, that it had taken five years to get the committee to conduct hearings on coal legislation, and that it had taken 20 years for Congress to pass railroad legislation and to establish the parcel post system in the face of strong opposition.

In urging the creation of a fact-finding agency, Mr. Fish said: "Until we have information obtained by such an agency, there can be no constructive coal legislation. I recommend that the committee confine its recommendation at this session to legislation creating a fact-finding agency, which can be followed later by measures for mediation of coal strikes, and for handling emergency situations. I am opposed to Government operation of mines or price fixing." Representative Huddleston, Democrat, Alabama, a member of the committee, did not think publicity would accomplish much.

"Which is the most important, a continuous supply of coal or a fair price for coal?" asked Representative Parker.

"A continuous supply, of course," said Mr. Fish.

"Has the public a duty to the coal industry to match its claim to interfere with it?" asked Representative Huddleston. "What right has the public to a supply of coal when it is not interested in reasonable profits or wages to those engaged in its production? When we deal with the mining industry, it is not simply a proposition of looking after the public. Continuity of supply and reasonableness of price are merely symptons affecting the industry. We must get to the root."

"Place every authority possible in the hands of the President of the United States to deal with an emergency as it may arise," advised Representative Treadway. "Do not hamstring him. Give him such authority that there can be no suspension of production."

It developed during the hearings that Secretary of Commerce Hoover has not recommended coal legislation nor has he taken steps to draw up a plan for creation of machinery for arbitration of coal mine labor disputes.

NEW MINE-SAFETY FILMS PRODUCED

THREE new mine-safety motion-picture films, of one reel each, produced by the Bureau of Mines in cooperation with one of the larger coal mining companies, are now available for distribution.

"Twelve Points of Safety" is the title of a film designed to impress upon mine officials and miners a few of the most important safety measures to be taken in connection with the daily operation of coal mines.

The necessity of using only closed lights is the first point brought out. The importance of using only mine lamps that have been approved by the Bureau of Mines is also stressed. Views of various types of approved mine lamps are shown. The second safety point emphasized is the prevention of matches and smoking material being taken into the mine. The third safety point visualized is the necessity of testing each working place, before work starts, as a safeguard against bad roof and the presence of explosive gases, flame safety lamps being used for the last-named purpose. The taking down of loose roof is the fourth point emphasized. Views are shown of employes testing the mine roof to determine its condition and placing props where needed. The fifth safety point is the using of water on the cutter bar of the coal-cutting machines for the purpose of keeping down coal dust. It is shown how the dry cutting of coal produces a dangerous cloud of coal dust, whereas the use of water eliminates such hazardous dust clouds. The sixth safety point is the wetting of the coal before shoveling it into the mine cars and the passing of the loaded cars under sprinklers on the way to the mine shaft, being another precaution against the accumulation of dry coal dust. The provision of ample traveling way between the coal rib and the cars, as a preventive against the crushing of employes by moving trains is the seventh point to be illustrated. The whitewashing of the shelter holes, in which employes place themselves for safety as coal trains pass, and the keeping of such holes free from rubbish, constitute the eighth safety point. The ninth point emphasizes the need of using only permissible explosives. When used as recommended, permissible explosives have never been known to cause a mine explosion. The use of finely pulverized rock-dust for the prevention of coal-dust explosions is the tenth safety point. The spreading of rock-dust throughout the mine by means of rock-dust distributors is illustrated. Views showing a mine entry before and after rock-dusting illustrate vividly the increased illumination attained as a result of rock-dusting. The eleventh safety point is the maintenance of mine fans capable of supplying ample fresh air throughout the mine to sweep away dangerous accumulations of gas. The twelfth safety point is the taking of samples of mine air as a guide to control the ventilation. Scenes depicting the collection and analyzing of mine-air samples are shown.

"First Aid to the Injured" is the name of a one-reel film illustrating the proper methods of emergency treatment to be used in case of some of the mishaps encountered in the work of mining. Methods of giving artificial respiration to victims of electric shock, apparent drowning, and carbon monoxide poisoning are depicted, and the administration of oxygen in appropriate cases is shown. The dry, sterile dressing of open wounds is illustrated. An ingeniously devised scene illustrates the three types of bleeding from wounds—from capillaries, from veins, and from arteries. Methods of controlling these different types of bleeding are illustrated. The making of tourniquets and their application are shown. First-aid experts of the Bureau of Mines are photographed as they demonstrate the application of splints and bandages for use in cases of dislocations and fractures of bones. The treatment of burns is depicted. The proper way of carrying an injured man so that no further injury may result is demonstrated. Means for improvising stretchers out of jackets, coats, etc., are illustrated.

"The Use and Care of Mine Rescue Apparatus" is a one-reel film depicting the use and care of self-contained oxygen breathing apparatus employed in mines and other places. Four types of apparatus — the Paul, Gibbs, Fleuss-Davis, and McCaa—are shown in detail. The circulation of oxygen through the apparatus is illustrated. Methods of charging and testing the oxygen bottle are depicted. An interesting series of views shows a mine-rescue crew equipped with oxygen apparatus exploring a mine. The methods employed by the crew in testing the mine atmosphere with flame safety lamps and carbon monoxide detectors are illustrated. The use of the common canary for detection of carbon monoxide is shown, the bird being seen as it is overcome by gas, then afterwards treated and revived.

Copies of any or all of these three educational motion-picture films may be obtained free of charge for exhibition by schools, churches, clubs, civic organizations, and other bodies by applying to the experiment station of the United States Bureau of Mines, Pittsburgh, Pa. Transportation charges both ways are paid by the exhibitor.

SHAKING SCREENS AT COAL MINES

SHAKING screens have been so widely used in the last 25 years that they have practically displaced other types of machines for screening coal intended for the general market. First the bar screens were replaced by shakers for the grading of coarse coal (sizes over 1¼ or 2 inches), and during the last 15 years even the revolving screens for coal below these sizes have given way to special forms of shaking screens.

The screening medium—punched plate or wire cloth—is carried in a rectangular frame of wood or steel, inclined at a low angle and suspended from or supported by loose rods. This frame is attached by a connecting rod to an eccentric or other mechanical device for giving a reciprocating movement. Material fed on the upper end of the screen slides down the inclined screening surface, especially on the back stroke, and the finer sizes fall through the perforations. The screening surface is usually round-hole plate, although flanged-lip screen, wire cloth, or bars are used in some screens. If the screening surface is replaced or covered by blank plate, the screen is said to be veiled. In order to prevent their movement causing vibration of the building, shaking screens are usually hung in pairs and driven in opposite directions from the same driving shaft by eccentrics or cranks spaced 180° apart.

Although shaking screens are widely employed in sizing ores, stone, and gravel, they are chiefly used to prepare coal at mines where the output is being marketed as steam and domestic fuel that needs separation into a number of sizes. Screens of this type are peculiarly successful in the ordinary plants that load coal by grades into railway cars on parallel tracks, because during the screening the various sizes are distributed to convenient points for loading directly in cars on the separate tracks. Additional conveying machinery is therefore only necessary where flexible conveyors or loading booms lower prepared sizes gently into the cars to avoid breakage. Shaking screens have an additional advantage—one screen of suitable width can handle the entire output of a mine.

Detailed descriptions of the various types of shaking screens are given in Bulletin 234, recently issued by the Bureau of Mines.

The title of Safety Service Director of the Bureau of Mines has been abolished, following the resignation of Dr. T. T. Read. Dr. R. R. Sayers, chief surgeon of the bureau, has been placed in temporary charge of the safety work of the organization, with the title of Acting Chief Engineer, Safety Service.

ZINC PIGMENTS AND SALTS SOLD IN 1925

ZINC pigments and salts sold by domestic manufacturers in the United States in 1925 had a value of $42,980,145, according to a compilation made by the Bureau of Mines from reports submitted by producers. In 1924, sales valued at $37,953,110 were reported.

The products covered by the reports include lithopone, zinc oxide, leaded zinc oxide, zinc chloride and zinc sulphate.

For 1925 an increase in sales is shown for every product except zinc chloride, in which there was a loss of 11 percent. This loss was coincident with a gain of 10 percent in the average value per ton.

Lithopone and zinc oxide showed the largest sales in the history of these industries, making gains of 32 percent and 17 percent, respectively, over sales in 1924. The average value per ton, however, was lower than in the preceding year.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1924 and 1925

	1924			1925		
	Short tons	Value		Short tons	Value	
		Total	Per tons		Total	Per ton
Lithopone	109,469	$12,531,397	$114	145,019	$15,045,675	$104
Zinc oxide*	131,470	19,784,257	150	153,940	21,695,597	141
Leaded zinc oxide*	26,729	3,356,965	126	31,750	3,966,282	125
Zinc chloride†	51,054	2,051,782	40	45,619	2,002,828	44
Zinc sulphate	4,674	228,709	49	5,332	269,763	51

*Zinc oxide containing 5 percent or more of lead is classed as leaded zinc oxide.
†50° Baumé.

PRODUCTION OF SLAB ZINC AND ROLLED ZINC IN 1925

PRODUCTION of slab zinc at zinc reduction plants in the United States in the year 1925 amounted to 611,645 short tons, valued at $92,970,000, according to statistics compiled by the Bureau of Mines. This compares with the 1924 production of 552,825 short tons, valued at $71,867,000. Of the 1925 output, 572,946 tons was primary production, 555,631 tons being from domestic ores and 17,315 tons from ores originating in Canada and Mexico. Redistilled secondary production amounted to 38,699 tons.

Oklahoma, where 138,906 short tons were smelted, led all States in production. Illinois, with 109,672 tons smelted, was second, and Pennsylvania, with 99,899 tons smelted, was third.

The apparent consumption of primary zinc in the United States in 1925 amounted to 500,147 short tons, as compared with a consumption of 448,257 tons in 1924.

Rolled Zinc in 1925

The total production of rolled zinc in 1925, as reported by producers, amounted to 142,263,945 pounds, valued at $14,514,234. As compared with 1924, these figures represent an increase of 17 percent in production and 26 percent in value. The average selling value per pound in 1925 was 10.2 cents as compared with 9.5 cents in 1924.

The base quotation on sheet zinc, f.o.b. works, showed some slight fluctuations during the year. The quotation at the beginning of the year was 11 cents a pound; at the end of the year it was 12 cents. The lowest figure was 10 cents, price quoted from the middle of April to the middle of June.

MAGNESIUM PRODUCTION INCREASES

SALES of magnesium in the United States in 1925 amounted to 245,000 pounds, valued at $274,400, as compared with sales of 128,000 pounds, valued at $150,000 in 1924, according to statistics compiled by James M. Hill, of the Bureau of Mines. But two companies manufacture magnesium in the United States and both companies increased their output in 1925.

Over 81 percent of the magnesium was sold in ingot form, but the sales of alloys and castings more than doubled those of 1924. Sales of tubing amounted to about one-fifth as much as in 1924, but sales of sheet were over one hundred times those in the previous year. The average price of domestic ingot metal was 86 cents a pound, that of powder $1.63 a pound, and of castings $3 a pound.

Imports of magnesium metal in 1925 were 8,326 pounds, valued at $7,070, as compared with 8,738 pounds, valued at $6,561, in 1924.

ALUMINUM SALTS IN 1925

THE production of aluminum salts in the United States in 1925 was 335,480 short tons, valued at $13,155,790, according to statistics compiled by James M. Hill, of the Bureau of Mines. This compares with production in 1924 of 302,190 tons, valued at $9,301,410.

The aluminum salts industry consumed 122,340 long tons of bauxite in 1925, as compared with 106,150 tons in 1924. There was also consumed 440 tons of aluminum metal, which was used in the manufacture of alumina hydrate.

QUICKSILVER IN 1925

THE quicksilver production of the United States in 1925 amounted to 9,174 flasks, of 75 pounds each, according to preliminary figures compiled by the Bureau of Mines. The country's output of quicksilver in 1924 was 10,085 flasks. The 1925 production was made up by seven mines in California and six in Texas, Nevada, Arizona, and Idaho. Oregon, as well as the States named, produced in 1924. Based upon the average New York price per flask for 1925, $83.128, the value of the year's production was $762,616. The imports of quicksilver in 1925 amounted to 11,245 flasks from Italy and 9,754 flasks from Spain, and from the balance of the world 1,782 flasks, making a total of 22,781 flasks. The exports were 204 flasks. In 1924 the imports were 13,170 flasks and exports 208 flasks. On January 1, 1925, there were 68 flasks in bonded warehouses; in August, 2,577 flasks; and on January 1, 1926, 1,181 flasks. The average price for 1924 was $69.761. In 1911 the imports exceeded the exports by 6,001 flasks. Prior to this date exports had exceeded imports. During the period 1911 to 1925 the imports have gradually increased, showing the growing dependency of the domestic consumers upon foreign sources.

PRODUCTION OF BAUXITE IN UNITED STATES IN 1925

THE production of bauxite in the United States in 1925 was 316,540 long tons, valued at $1,988,250, a decrease of 9 percent in quantity and 7 percent in value as compared with the domestic production of 347,570 long tons in 1924, according to a statement prepared by the Bureau of Mines.

Imports of bauxite in 1925 amounted to 353,696 long tons, while exports, largely bauxite concentrates, were 78,570 long tons. In 1924 imports were 201,974 long tons and exports 77,065 long tons.

The following is a statement of domestic bauxite sold by producers to industries in 1924 and 1925 in long tons:

Year	Aluminum	Chemicals	Abrasives, refractories, and cement	Total
1924..	225,780	54,870	66,920	347,570
1925..	173,040	67,420	73,980	314,440

The production of bauxite in the Arkansas field was 296,320 long tons in 1925, a decrease of approximately 10 percent as compared with 1924. The eastern field, including Georgia and Tennessee, produced 20,220 tons, but only 18,220 tons were sold, a slight decrease as compared with 1924. No bauxite was produced in Alabama or Mississippi in 1925. The imports of bauxite in 1925 increased about 75 percent, as compared with 1924, and came chiefly from British and Dutch Guiana, South America, though some French and Dalmatian bauxite was received.

THE FLUORSPAR INDUSTRY IN 1925

NOTWITHSTANDING the large production of steel in 1925, the shipments of domestic fluorspar, according to the Bureau of Mines, amounted to only approximately 113,600 short tons, valued at about $2,052,000, decreases of 9 percent in quantity and 16 percent in total value as compared with 1924. The general average price per ton f.o.b. mines or shipping points for all grades in 1925 was $18.06, which is $1.55 less than the average for 1924. The shipments to manufacturers of glass and hydrofluoric acid were larger than in 1924, but smaller shipments were made to steel plants, foundries, and enamel and sanitary establishments. Exports of fluorspar, though small, were more than in 1924.

The total stocks of fluorspar at mines or shipping points were decreased some during 1925, but they are still large, amounting to about 18,400 short tons of gravel fluorspar, 3,500 tons of lump fluorspar, and 600 tons of ground fluorspar, a total on January 1, 1926, of about 22,500 tons of "ready-to-ship" fluorspar. In addition there was in stock at mines at the close of 1925 about 41,800 short tons of crude fluorspar, which must be milled before it can be marketed, estimated to be equivalent to about 24,000 tons of merchantable fluorspar. These stocks compare with 40,400 tons of "read-to-ship" fluorspar on January 1, 1925, and about 29,000 tons of crude fluorspar.

Based on reports furnished by manufacturers who produce about 93 percent of the total basic open-hearth steel, the consumption of fluorspar at all basic open-hearth steel plants in 1925 amounted to about 136,900 short tons, and the stocks at such plants on January 1, 1926, amounted to about 49,000 short tons, which compares with 119,800 tons consumed in 1924 and stocks of 64,000 tons on January 1, 1925.

The imports of fluorspar into the United States in 1925 were 48,700 short tons, valued at $468,847, decreases of 5 percent in quantity and 16 percent in total value as compared with 1924. As usual, the United Kingdom was the principal source of imports, followed by Germany and British South Africa, but noteworthy increases are recorded for France and Italy.

The following tables show details of the fluorspar statistics for 1925, which are subject to revision. The figures for 1924 are final:

Fluorspar shipped from mines in the United States, 1924-1925, by states

State	1924 (final) Short tons	1924 (final) Value Total	1924 (final) Value Average	1925 (preliminary) Short tons	1925 (preliminary) Value Total	1925 (preliminary) Value Average
Illinois	62,067	$1,288,310	$20.76	54,400	$1,025,000	$18.84
Kentucky	47,847	988,940	20.67	44,700	832,000	18.61
Colorado	12,301	135,411	11.01	14,500	195,000	13.45
New Mexico	2,580	38,470	13.92			
Utah	184					
	124,979	$2,451,131	$19.61	113,600	$2,052,000	$18.06

Fluorspar shipped from mines in the United States, 1924-1925, by uses

Use	1924 (final) Short tons	1924 (final) Value Total	1924 (final) Value Average	1925 (preliminary) Short tons	1925 (preliminary) Value Total	1925 (preliminary) Value Average
Steel	104,349	$1,849,073	$17.72	91,489	$1,479,417	$16.17
Foundry	7,138	159,533	22.35	6,477	123,879	19.13
Glass	6,094	214,288	35.16	6,767	211,331	31.23
Enamel and sanitary ware	3,471	120,955	34.85	3,237	101,060	31.22
Hydrofluoric acid	3,150	89,413	28.39	4,455	114,059	25.60
Miscellaneous	160	3,380	21.13	120	4,680	39.00
Exported	617	14,489	23.48	1,055	17,574	16.66
	124,979	$2,451,131	$19.61	113,600	$2,052,000	$18.06

PRODUCTION AND IMPORTS OF PYRITES INCREASE IN 1925

THE production of pyrites in the United States in 1925 amounted to 170,081 long tons, valued at $650,448, according to figures compiled by the Bureau of Mines. This is an increase of 6 percent in quantity, but only 1 percent in value, as compared with the 1924 output, which was 160,096 long tons, valued at $645,262. The quantity of pyrites sold and consumed by producing companies also increased 6 percent, or from 160,075 long tons in 1924 to 170,298 long tons in 1925. In 1925, as in 1924, the pyrites production was made in California, New York, Ohio, Virginia, and Wisconsin. The combined production of California and Virginia was 163,773 tons, 96 percent of the total for the country.

The imports of pyrites in 1925 amounted to 276,385 long tons, valued at $773,925, compared with 246,737 long tons in 1924, according to the Bureau of Foreign and Domestic Commerce. Nearly all of the imports came from Spain, with small amounts from Canada.

SAMPLING OF QUICKSILVER

THE accurate sampling of ore in place is probably more difficult for quicksilver than for the majority of other metals, states the Bureau of Mines in Bulletin 222, recently published. When quicksilver occurs native the reason is obvious. The friability of cinnabar, and its tendency to occur in fissures and cracks of the country rock, make particularly difficult the securing of a true sample from a working face. Particles of cinnabar always tend to break off from the point where the cut is being made, and thus increase the mercury content of the sample. On the other hand, in the sample itself, much of the mineral is liable to be in the fine material, so care must be taken to see that none of this is lost. The sampling of ore in place should only be intrusted to some one who is familiar both with the peculiar characteristics of quicksilver ores in general and of the particular formation sampled.

Little development work in advance of actual mining is usually performed in quicksilver mines. For this reason, also because of the extremely irregular occurrence of the mineral in most places, the working face must be sampled after each blast so that ore can be properly selected with reference to the average grade that is to be delivered to the reduction works. This estimation of the grade of the ore can sometimes be made by inspection; frequently the ore is panned with a 6-inch pan for this purpose. Miners, after they become familiar with a particular deposit, show a remarkable expertness in estimating the mercury content of an ore in this way.

The regulation of metallurgical treatment in the quicksilver industry by systematic sampling and assaying has not, in general, been nearly so well developed as in other branches of metallurgy. The relatively small scale of most quicksilver plants and certain inherent difficulties in accurate sampling are the main reasons for this. Also the simplicity of quicksilver metallurgy makes elaborate sampling less necessary than for other ores. In the ordinary course of ore treatment there are no intermediate products to consider, and, in general, little retreatment of material, consequently relatively few samples need to be taken. On the other hand, there can be no question as to the desirability of exact knowledge in controlling quicksilver reduction. The possession of data from which a metallurgical balance could be prepared would often save the quicksilver operator much guesswork and improve efficiency of operation.

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

Senator Ralph H. Cameron, of Arizona, is very definitely of the opinion that the salvation of the copper industry is a protective tariff. In a lengthy speech on the floor of the Senate, advocating a duty of 6 cents a pound on imported copper, he said:

"The copper miner of our country is entitled to protection from the cheap competitive labor of Africa and South America.

"The domestic producer of copper is confronted with constantly increasing labor, supply, tax, and capital requirement costs. Yet in the face of constantly increasing costs we find copper selling below its average sale price for the past 30 years. This is a dangerous economic situation in view of the universally higher prices existent today for practically all commodities when compared with the average prices for those commodities during the past 30 years; and strikingly so when consideration is given to the facts that copper is one of our essential metals, and that in the whole realm of metal production the annual gross value of copper produced is only exceeded by that of pig iron.

"At the present time it is estimated that about one-third of our domestic copper production is in economic jeopardy due to marketing of copper at cost; with a further decrease in the selling price of copper, say to 13 cents per pound, about 65 percent of the domestic copper will be marketed at a loss.

"The ruin confronting the domestic copper producer will be passed on to the copper miner and all those citizens and communities dependent on the continued mining of copper within our country.

"At the present time the foreign producer of copper can ship an unlimited poundage of copper ingots into this country free of duty. The poundage so imported means an equivalent lessened copper production within our home areas. This cheap foreign-labor copper can be delivered in quantities sufficient to supply all our domestic needs and at a price greatly below our cost of production. This unlimited importation of copper free of duty into this country will destroy our copper-mining industry; in consequence destroy the livelihood of our miners and all those dependent on the continued mining of copper within our domestic copper areas."

Taking another position on the hope of the copper industry *Engineering and Mining Journal-Press* editorially indorses the copper industry entering the manufacturing industry as a way out of its difficulties. They say:

"Copper producers have been told on various occasions that their salvation lay in expanding their activities so as to include manufacturing of finished products. Therein, it is said, reside the big profits. That this contention is not unsound apparently has been proved by Anaconda; and cor-

Beginning to Scratch — *Columbus Dispatch*

Welcome Home — *N. Y. Eve. Post.*

roborative evidence may be adduced by citing the New Jersey Zinc Co., the Aluminum Company of America, the International Nickel Co., and the U. S. Steel Corporation. All of these dig ores and sell manufactured products to the ultimate consumer, or at least to a customer well toward the end of the chain of buying groups; and all are enjoying reasonable prosperity.

"Suppose that through some combination of circumstances the productive capacity of the copper and brass fabricating plants in the United States should become considerably greater than the demand for products. It is likely that 'competitive conditions would become more and more severe and the margin of profit correspondingly reduced,' as happened in the case of lead pigments. Or, if by some miracle the copper mines of Chile and Peru should be wiped off the map, it is not improbable that consumption of copper and possible world production would so nearly coincide that the copper-mining industry, by and large, would be as profitable as lead mining has been during 1925. It is conceivable, then, that Anaconda's copper mines would far eclipse its manufacturing plants as money makers, for the time being at least.

"Manufacturing profits, in proportion to the capital investment involved, are subject to definite limitations; but there are no comparable limitations with mining. This follows from a logical course of reasoning: If one manufacturer can make copper boilers for $5, it is reasonable to believe that any number of others can do nearly as well. Accordingly, no matter what the demand, the profit to any manufacturer cannot be more than, say, $1 per boiler. But because a company with a large, rich, or otherwise favorably circumstanced mine can produce refined copper for 5 cents per pound, it does not follow that owners of other mines can do approximately the same thing. If the production cost of the last 1,000 tons of copper required to supply the demand is more than 12 cents per pound, the selling price for all copper should be something above 12 cents per pound. Accordingly, the profits of producers who can make it for 5 cents or 6 cents or 7 cents will be proportionately larger.

"A good argument can be advanced to support the plan of creating 'vertical' combinations to include mining, smelting, refining, and manufacturing operations. A company with all these activities is more likely to avoid bad years, because of the diversity of its sources of income. But the fact remains that mining, as a consequence of inherent characteristics, affords the possibility of very large returns on capital investment, which is lacking in a manufacturing enterprise."

Senator Sheppard's bill providing for an investigation of the potash reserves of America has passed the Senate and, according to the *Wall Street Journal*, German and French potash producers, formidably organized, have divided the foreign market between themselves, while we are awaiting legislative action to discover whether we have potash in commercial quantities in this country. This paper further states:

"This may be included among our 'view with alarm' cases; the question is, what can we do about it? There are different answers, some from august official quarters, of which upon analysis resolve themselves into one: Nothing.

"In the situation there is nothing novel. Previous to the war Germany had a world-wide monopoly on potash production, and somehow we managed to get along very well. The cession of Alsace to the French broke the monopoly, and then made a dual ownership. French and German owners took steps to cement this partnership by entering into an agreement providing for no new mines to be opened by the French, fixing a scale of prices high enough to assure them a profitable operation, and giving Germany 70 percent, and France 30 of the world trade. This agreement, which expires May 1, 1926, is now to be replaced by a long-term agreement essentially on the same lines.

"That is the situation, and it does not seem to change matters to any great extent. Our interest is that we import considerable potash for indus-

Wallace Press-Times

A Forward Looking Gentleman

Wallace Press-Times

Still Sawing Wood

trial and agricultural purposes. In 1925 we imported 860,000 tons of potash fertilizers, duty free, valued at about $14,000,000. Probably our imports from year to year will be about those of last year, with a tendency to increase. As we need the potash, we must deal with this monopoly. Refusal to loan money certainly will not scare it, much less bring it to its knees. So long as the security is good and the interest paid others outside the United States will be ready to make such loans. We cannot profitably refuse to buy, and there we are.

"There is one other way in which monopolies are sometimes effectively met. That is by entering the production field and competing with them. We can do this if we choose. During the war potash was produced in the United States, but the cost of production was high. A tariff imposed now on potash fertilizers would raise a storm of protest.

"Plainly, the only hope we have of meeting the French and German monopoly is through the discovery of large deposits in the United States. Claims are made that there are such deposits in Texas. But if they are there, they are still under ground, while prospecting is both expensive and speculative. It is a fact also that successful enterprise of the sort is not treated any too kindly in the United States.

"This is the potash situation, and after running around the circle we come back to the starting point, where it seems more comfortable to do nothing."

Asserting that the diminution of the talk concerning "the living wage" is a direct indication of a general trend in economic thought, the *American Metal Market* says:

"It is refreshing to reflect upon the progress general economic thought has made of late, even though a great deal more is needed. In particular the talk about 'the living wage' has dwindled to small proportions.

"This talk reached its height in 1921 and 1922. It was heard in many quarters and was pressed particularly by the labor unions before the Railroad Labor Board, which eventually refused to consider the principle.

"What was obvious to thinking people at the time has been proved correct by developments since then. Why do we hear so little now about 'the living wage?' Chiefly because the remedy to the objectionable conditions has been applied by circumstances, in a natural way and not by artificial means.

"It was claimed then, when there was so much talk about 'the living wage' that raising wages of a given group would simply make that group more competitive with other groups, that there was only so much to be bought, and if more money were distributed, more money would simply be paid for the same things. What was needed was more production.

"Now we have more production, through men working harder and more efficiently. There is an ample supply of statistics to show that 'real wages,' i. e., actual wages corrected for purchasing power, are the highest ever.

"There has been a tremendous increase in efficiency since 1920, which undoubtedly marked the height of inefficiency. The reference is not merely to wage workers, but to everybody and everything. Business men are much more efficient. Transportation is much more efficient.

"Having lived down this economic fallacy of getting 'the living wage' simply by increasing wage disbursements, it does not follow that we are on economically sound ground. As long as human nature is as it is we shall never be permanently on a perfectly sound economic basis."

San Francisco Chronicle

Why Boys Leave Home

The New York Evening Post believes that the decision which the British Government must make before May 1 to be one of the gravest decisions ever made in their political and industrial history. Their comment is enlightening and follows:

"Within a month the British must make one of the gravest decisions ever made in their industrial and political history. Last July they faced the sudden danger of a mine strike. Mine owners found themselves unable to operate without cutting wages and increasing the hours of the miners. Coal exports were decreasing. Every shipload exported meant the loss of a shilling a ton.

"Many pits were closing and about 67,000 mines were jobless, but the British miners refused to give up their hard and war won advantages. They were ready to strike. They hoped to revive the 'Triple Alliance' of the crisis of 1921 and have the help of the engineers, rail workers and transport men.

"The British Tory Government, in a semi-panic yielded. It gave the owners and miners a subsidy that has amounted to 60 cents a ton. This enabled them to continue the old wage scale without loss to themselves, and the miners' hours of labor were not increased.

"This was a stop-gap compromise, a mere truce, which is to expire on May 1. By that date it will have cost the British taxpayers $115,000,000.

Meanwhile, the British Coal Commission, composed of one British official, one cotton spinner, one professor and one soldier, has investigated the coal situation and made a report for the guidance of the people, the miners and the Government.

"This report is more of a diagnosis than it is a remedy. It recommends that the subsidy shall stop, never to be revived. It asks that the nation buy up the mines, and this would mean an expenditure of about $500,000,000 to the royalty holders. Other recommendations suggest the closing up of unprofitable mines, the dismissal of 100,000 miners and a national commission to act as a high court of last resort in settling the future troubles of the industry.

"The report was made public March 10. All Britain is debating it. There is, however, nothing to indicate any change of heart on the miners' part. In some way or another the present costs of mining must be reduced 94 cents a ton if British markets are to

Chicago Tribune

Ancient Fables and Modern Facts

N. Y. Eve. Post

Up At Last

be regained. The miners are refusing to give up the wage increase they won in 1924. If they stand fast the Baldwin Government and the British people must decide whether to go on paying the subsidy or face a strike that will paralyze the country.

"The British have a genius for compromises, but this time a compromise may fail. The consequences of failure may be grave indeed. Every mine will close. When the miners quit there is every reason to expect similar strikes will paralyze shipping, motor transport and the railways, closing the factories for lack of raw material and menacing the food supply of the country.

"In 1921 the Government dealt with a like crisis and was preparing to meet another last July. These preparations are again under way. The Government is organizing its own motor transport. Thousands of volunteer police and constables are being mustered to preserve order.

"Under a fairly serene surface arrangements are being made to deal with what may prove a war between labor and capital. In the shadow of a great general strike, crowded with danger and unprecedented in magnitude, the fearful word 'revolution' is on the lips of many Englishmen.

"Staggering financial losses are certain and bloodshed is at least a possibility if the miners strike on May 1. The situation is so grave the Baldwin Government may find some way of extending the subsidy, regardless of the fact that British taxpayers have poured at least $350,000,000 out to the coal trade since 1914, and are paying nearly $6,000,000 a week in doles to the unemployed.

"The Tory Government is shrinking from the impending test. The British public is uneasy. Both the operators and the miners seem ready for the conflict. Yet the boldest prophets of Britain find it impossible to predict the outcome. Britain has muddled through such crises before, and there is always that British gift for makeshift settlements and that British genius for compromises on the very ragged rim of disaster."

The eternal "Why" is still being reiterated by the coal trade press when discussing what is the matter with the bituminous coal industry. *Coal Mining Review* is of the opinion that the operators themselves should answer this question. They further say:

"Why should this most important industry be completely demoralized, operators of coal mines disorganized, and continually engaged in conflict, legal or otherwise, to settle the labor problem or sales problems? Why should there be fights over freight rate differentials to determine to whom certain markets for coal belong, to decide how much below the cost of production coal should be sold rather than to decide that no coal shall be sold at a loss? Why does such a condition exist? It is the operators of coal mines who ought to answer these questions. They can remedy the conditions which are destructive to the bituminous coal industry.

"Why does this most important industry be demoralized by the mine workers generally being divided, and the organized miners be continually engaged in strikes or industrial conflicts to settle the labor problem, to change freight rates when strikes are a failure, to establish artificial standards of wages which economic conditions will not justify, to compel friendly operators to suspend the operation of their mines on account of inability to operate in competition with mines where lower mining rates and wages are paid for the same kind of labor, and finally ignore the rights of all operators by insisting that the demands of the miners, right or wrong, must be granted or the operators confronted with a strike.

"Who is responsible for such a condition as now exists? It is the miners' leaders who have formulated the policies which are responsible. They can help remedy the policy which is so destructive to the coal mining industry. It would seem that it is a part of their duty in the interest of and for the benefit of the hundreds of thousands of miners whom they directly represent to try and formulate some new policy which will protect the rights of the miners, guarantee the people of the United States a continuous supply of coal at a price, per ton, which will permit the payment of an American standard of wages and allow the earning of a reasonable profit on investments in operating coal mines."

The Retail Coalman is of the opinion that stabiliza- (*continued on page* 394)

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

Summer Course in Coal Mining at Carnegie

In cooperation with the Pittsburgh station of the United States Bureau of Mines, a four weeks course in coal mining will again be given by the Carnegie Institute of Technology during the coming summer.

The work of the course will be given from June 14 to July 10. Under special arrangements, and for the benefit of the students of the summer course, a special examination for fire bosses, assistant mine foremen, and mine foremen will be held at Carnegie Tech by the Pennsylvania Department of Mines immediately following the course, on July 12, 13, and 14. The course is planned to prepare each student to pass these examinations.

Each student who satisfactorily completes the course will be awarded a certificate by the Carnegie Institute of Technology and a mine-rescue and first-aid certificate by the United States Bureau of Mines.

Plan Development of Large Hard Coal Veins in Virginia

Large veins of anthracite coal have been discovered at Gunton Park, in Wythe County, Va., and plans are under way for developing them extensively during 1926, according to Luther R. Fair, mineral land assessor for the State Corporation Commission.

While anthracite is being mined on a comparatively small scale at several points in southwest Virginia, the Gunton Park Anthracite Collieries, of Pulaski, are planning to mine it at Gunton Park in larger quantities than ever before in the history of the state, according to Mr. Fair.

The veins of excellent quality anthracite 5 and 6 feet wide, and separated by only about 8 feet of slate, have been found at the Wythe County mine, which has its development already under way.

The present limited equipment there will be expanded and the most modern appliances will be secured. Mr. Fair believes the Gunton Park anthracite is the nearest approach to the Pennsylvania variety yet found outside of that state.

The Old Ben Coal Corporation has acquired mining properties in West Virginia and has also established connections with various operating companies in eastern and western Kentucky, all of which are nonunion fields. The Old Ben Corporation, one of the largest producers of coal, has 12 large mines in southern Illinois, but only two of them are producing.

Ten of its southern Illinois mines were closed, it was stated, because of noncompetitive conditions brought about by the war-time agreement with the miners' union.

The new fields the corporation will enter are not affected by union requirements.

Business Men to "Boost Anthracite"

The Pottsville, Pa., Rotary Club has started a campaign to "boost anthracite," and to impress fuel users with the merits of anthracite as a fuel and with the future possibilities of the industry. At the meeting inaugurating this campaign, Owen L. Underwood, Pottsville business man, stated that one-half of the unmined anthracite is in Schuylkill County, and he predicted that within the next century at least one-third of all the anthracite produced would come from that county. At present, he said, about 77 percent of the 48,000 industrial employees in Schuylkill are on the anthracite pay rolls, and of the $92,000,000 paid out as wages in the county every year, about $83,000,000 goes to anthracite workers.

W. Wesley Miller, of Ardmore, Pa., claims to have perfected an invention for separating the solid content from mine tail waters, so that the latter is discharged from its device practically clear, in a continuous operation and at great capacity.

Begin Work on Large Coke Oven

Construction has been started on a huge coke oven at the plant of the New England Fuel & Transportation Co. in Everett, Mass., which will be a necessary adjunct to the new Mystic Iron Works. The iron works is rapidly nearing completion, and it is expected that the new coke oven will be in operation within a short time after the blast furnaces of the works are ready. The new coke oven will be of the most modern type, and involves an outlay of $850,000.

Nations to Confer on Oil Pollution

A conference of maritime nations has been called by the United States Government to meet in Washington June 8 for the purpose of "dealing with the problem of oil pollution through international agreement." Invitations have been sent to Belgium, Denmark, France, Germany, Great Britain, Greece, Italy, Japan, the Netherlands, Norway, Spain, and Sweden. Conclusions of an interdepartmental committee which led to the conference called by Secretary Kellogg point out that oil pollution exists in a more or less aggravated form along the Atlantic, Gulf, and Pacific coasts, and along the coasts of the principal maritime nations.

The largest initial production of high-gravity oil ever found in an oil well in the United States is said to have come from Sinclair Oil & Gas Co.'s No. 27 Hartley, Section 18-23w, Garber, Okla., field early in April. During the first six days of its existence it delivered into pipe lines 144,841 barrels of 44.7 gravity oil, an average of over 24,000 barrels daily.

What is believed to be the deepest commercial oil well in the world, and is the largest producer in California since the close of 1923, is well No. 26 Lloyd at Ventura, of the Associated Oil Co., recently completed, flowing 6,800 barrels of 28 gravity oil and 3,000,000 cubic feet of gas during an 18-hour test. The depth of the hole is 5,925 feet, with production coming from 1,346 feet of sand.

Marine Consumption of Fuel Oil

According to returns received by the American Petroleum Institute from the principal companies engaged in the marine fuel oil business 79,173,000 barrels of fuel oil were delivered for ships' bunkers at United States ports and at United States insular possessions in 1925, compared with 80,880,000 barrels in 1924, a decrease of 1,707,000 barrels, or 2.1 percent. This is exclusive of fuel oil delivered to the United States Navy. The United States Navy in 1925 consumed approximately 6,300,000 barrels, compared with 6,300,000 barrels in 1924, this including Diesel oil and covering consumption by naval vessels, but not including consumption at yards and stations.

Of the total deliveries of 79,173,000

barrels to merchant vessels in 1925, 50,925,000 barrels were domestic fuel oil and 28,248,000 barrels foreign fuel oil. Deliveries of domestic fuel oil totaled 50,925,000 barrels, compared with 57,456,000 barrels in 1924, a decrease of 6,531,000 barrels, and deliveries of 28,248,000 barrels of foreign fuel oil, compared with 23,424,000 barrels in 1924, an increase of 4,824,000 barrels.

End Year Without an Accident

The National Safety Council reports that 450 men employed by the Sault Ste. Marie Works of the Union Carbide Co. worked 365 days without a lost-time accident.

The fifteenth annual Safety Congress will be held at Detroit from October 25 to 30, according to an announcement by W. H. Cameron, managing director of the National Safety Council, with headquarters in Chicago.

D. C. Jackling Will Receive Mining Society Medal

The Mining and Metallurgical Society of America has awarded the gold medal of the society to Daniel C. Jackling, of San Francisco, for his achievements in the development of low-grade mines. Formal presentation of the medal will be made in October.

Mr. Jackling is a director of the Ray Consolidated Copper Co. in Arizona, the Chino Copper Co. in New Mexico, the Nevada Consolidated Copper Co., and is also interested in the production of low-grade porphyry coppers. When he undertook the development of a mountain of copper ore in Bingham Canyon, Utah, which had previously been considered too low grade for commercial use, he for the first time employed steam-shovel methods, after the practice in the iron mines on the Mesabi Range. This brought the Utah Copper Co. up to the production of 28,000 tons a day.

By reason of contracts and agreements between the Utah-Apex Mining Co. and the Utah-Delaware Mining Co., terms of which are announced, it is believed that the most energetic exploration and development campaign as yet undertaken in that portion of Bingham Canyon is made possible. The International Smelting Co., which, like Utah-Delaware, is a subsidiary of the Anaconda Copper Mining Co., and the American Smelting & Refining Co., similarly allied with the Utah-Apex interests, are also signatories to the agreements reached. Negotiations, it is thought, have reached a conclusion that is eminently fair to all the interests concerned.

University of Minnesota Testing Low-Grade Iron Ores

Two test furnaces are being constructed at the University of Minnesota to determine if low-grade iron ore on the ranges can be utilized commercially. The tests also will determine whether Minnesota is to become an iron-manufacturing district.

The experiments on low-grade ore have been under way for several years. The last legislature appropriated $30,000 a year to carry on this work. It is said that the experiments thus far have been successful in converting low-grade ore into iron briquets.

The principal obstacle to the smelting of iron ore in Minnesota has been the cost of fuel. Coke has heretofore been deemed necessary for this process. The new furnaces will use low-grade coal instead.

It is estimated that there are 30,000,000,000 tons of low-grade iron ore in northern Minnesota that will be made available if the university experiments are successful.

First Part of New Electrical Safety Code Now Ready

Rules for the installation and maintenance of electrical equipment in generating stations and substations are given in a new publication of the Bureau of Standards of the Commerce Department. These rules cover the general protective features of the station, as well as specific sections dealing with grounding, rotating equipment, storage batteries, transformers, conductors, fuses, switches, switchboards, and lightning arresters.

In 1915 the bureau first formulated the National Electrical Safety Code, designed to obviate accident hazards in the electrical industry. The new publication, above referred to, forms a part of the fourth or 1925 edition of this code. The revision was carried out under the rules of procedure of the American Engineering Standards Committee, and the revised code will no doubt be approved as an American standard at the next meeting of the committee. Other parts of the revised code, dealing with electrical utilization equipment, line construction, and radio installations will be issued as separate handbooks as soon as they can be prepared.

This first part of the code is known as Handbook 6 of the Bureau of Standards. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

Produce Aluminum by New Process

The Czechoslovakian Government has issued a patent to two local scientists covering a new process for the extraction of aluminum from clay silicate and bauxite. The method has been tested by the Ministry of National Defense, which has reported that aluminum free of iron and silicic acid can be produced from low-grade materials at lower cost than at present. A company has been organized to produce under the new process, and a plant secured, which was expected to start operations in April.

Urge Separate Rate Group in Southwest

The creation of a separate rate group in the southwest is urged in a brief submitted to the Interstate Commerce Commission by counsel for Arkansas, Texas, Oklahoma, the Southwestern Industrial Traffic League and other shipping organizations in that territory, in connection with the petition of carriers in the westtrn district for an increase in freight rates. The creation of such a group is justified, the brief states, because the southwest forms a homogenous rate territory from the standpoints of states in that territory and traffic handled.

C. H. Mead, an operator of the Winding Gulf Field of West Virginia, has taken over the duties of secretary of the Winding Gulf Operators' Association, made vacant by the resignation of George Wolfe.

Prospectors in Convention

The British Columbia Prospectors' Association, in conjunction with the Chamber of Mines of Interior British Columbia, proposes to hold a convention of prospectors at Nelson in May, when it is announced "Prospectors from anywhere on earth will be eligible to seats at the convention."

It is stated that the program has been prepared and includes contests in drilling, packing, etc., and that there will be two one-act plays presented at some time during the convention.

Losses in Milling of Precious Metal Ores

The object of a study of precious metal loss in present milling practice, being conducted by the Bureau of Mines at its Reno, Nev., experiment station, is to help eliminate waste in present milling; to aid the industry by identification and study of the mineral loss in tailings together with research on recovery of each particular mineral; and to bring out methods for control and improve known practice. An example of this kind of work is that which was done during the past fiscal year on the "Blue Ore" problem of the Black Hills of South Dakota. For a number of years many metallurgists have given their attention to the "Blue Ore" problem of the Black Hills. Mills unable to recover value of these ores are now closed. After a long series of research experiments results obtained by the Bureau of Mines indicate

a solution by the following simple method: A light roast (about 10 minutes) at low temperature (under 300° C.) to partly decompose the sulphides, as indicated by reduction of iron pyrites to the magnetic ferrous sulphide. Add sufficient lime and water to effect complete action to permanent alkalinity, to be followed by regular cyanide treatment. The average gold recovery by this method is more than 90 percent.

Refractories in Metallurgy of Zinc

In cooperation with the Missouri School of Mines and Metallurgy, the Bureau of Mines is conducting a study of the requirements of refractories for zinc smelting, of the refractory materials that meet these requirements, and of the location of deposits of suitable fireclays or other refractory materials, in an endeavor to find ways of improving the quality of the retorts, condensers, and furnaces used for zinc smelting. The cost of refractories, especially for retorts and condensers, is a large item in the cost of smelting zinc ores. The specifications which a fireclay must meet in order to be suitable for zinc smelting are very strict. The first phase of the investigation consists in determining properties of fireclays, now used, for comparison in testing new materials. Samples of the materials being used for retorts at a number of smelters have been collected and tests of refractory properties on these samples have been completed. Chemical analyses have also been completed and this phase of the investigation will be completed early in the current year. The second phase of the investigation includes similar tests of new materials.

Analysis of Copper-Palladium-Gold-Silver Concentrates

A copper-palladium-gold-silver ore is being mined at Salt Chuck, Prince of Wales Island, Alaska, from which a concentrate is produced that contains 40 to 50 percent copper, and considerable amounts of palladium, gold and silver. There has been much difficulty in obtaining assays for palladium, gold and silver from the mine, smelter, sampler, and umpire that check within reasonable limits. While the results for copper content have not been unusual, the results for palladium have varied as much as 0.8 oz. on 3 oz. material, results for gold differed by 0.1 oz. on 1.6 oz. materials, and for a silver content of 7 oz., results differed by as much as 4 oz.

The Bureau of Mines was requested to determine the causes of variation in the results of the different assayers, and to develop a satisfactory procedure for analyzing such ore. The methods developed as a result of this request are given in Serial 2731, by C. W. Davis, associate chemist, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

Specific Gravity Study of Ores

The purpose of an investigation being conducted at the Mississippi Valley Experiment Station of the Bureau of Mines, at Rolla, Mo., is to develop suitable apparatus and heavy liquids for the specific gravity study of ores and mill products. In some ores, a garnet ore for example, a chemical analysis is worthless, for there is no element in the garnet which is not present in the gangue. The only method available for analyzing such ores is the specific gravity method using heavy solutions. In other cases the use of heavy solutions is sufficiently accurate, and much more rapid than chemical analyses. The sink-and-float method of studying ores opens not only a new field but an exceptionally important one.

Several heavy solutions have been used with varying degrees of success. Some do not have sufficiently high specific gravities, some are decomposed by moisture absorbed from the air, some have too high a melting point, and others evaporate rapidly causing fluctuations in specific gravity. During the specific gravity studies, five iron ores, one garnet ore, and one flourspar mill tailing have been studied to determine the possibilities of their gravity concentration. The sink-and-float method has been demonstrated in several flourspar mill chemical laboratories, which look with favor upon the method as being rapid and sufficiently accurate for mill control work. It is hoped that the method will be adopted in more mill laboratories throughout the country.

Reports have been made by the Secretary of the Interior on 448 bills introduced into Congress during its present session.

These numerous measures provide for new or revised legislation covering activities of the various bureaus and branches of the Interior Department. Under the present practice, the Secretary of the Interior is called upon by the committees of Congress to make a report on bills affecting his department either recommending favorably or unfavorably on their passage with suggested amendments.

The 448 bills reported upon are believed to constitute the largest number ever introduced at a single session of Congress dealing with the Interior Department and illustrates the heavy volume of public business the department is being called upon to transact. The records of the department also show that the average number of letters received by the Secretary of the Interior amount to 903 daily and by the department 6,268 pieces of mail.

Explorations Continued in Northern Alaska

The topographic and geologic mapping of Naval Petroleum Reserve No. 4, at the northernmost point of the United States, that is being done by the Department of the Interior for the Navy Department, has involved three seasons of the most strenuous labors of numerous men from the Geological Survey, in which they have traveled thousands of miles by dog team in the dead of winter, and by canoe in the equally trying days of summer.

A further season's work is necessary to complete the major problems of geography and geology. This project is being carried out by a party composed of Dr. Philip S. Smith, the Survey's chief Alaskan geologist, and Gerald FitzGerald, topographic engineer, with two camp hands.

NATION'S VIEWPOINT

(*Continued from page* 391)

tion of the bituminous coal industry is well under way, pointing out:

> "The bituminous coal industry is being stabilized in all fields, or nearly all fields, in the country by shutting down the mines until production is now less than the demand. The movement started the week that the anthracite strike came to an end, and since that time, thanks to a blustery March, the reserve stocks of the retailers have been reduced to a remarkable degree. This weather was instrumental in a production of 10,691,000 net tons the second week of March, an increase of 2.2 percent over the production of the first week in March.
>
> "The coal season, 1925-1926, has not been a bad year for the bituminous coal fields as far as tonnage goes, but the universal complaint has been of lean profits. West Virginia and Kentucky have had large production and by reason of not working under the high wage scale of the Jacksonville agreement many of the companies have made some money. The Illinois, Indiana and Ohio fields have been hard hit both as to production and prices."

A sectional unit of the American Engineering Standards Committee has been organized to consider zinc coating of iron and steel with a view of prescribing specifications for zinc-coated products. H. S. Rawdon will have charge of formulating methods of testing these products.

NEW OIL FINDING AND DRILLING METHODS

DURING the past few years scientific instruments, such as the seismograph and torsion balance, have been used with considerable success in locating structures that are favorable for the accumulation of oil, particularly in the Gulf Coast district, where oil is usually found associated with salt domes, according to H. H. Hill, chief petroleum engineer, Bureau of Mines. The diamond drill has also been used successfully in Oklahoma for locating structures that are not evident on surface indications. The discovery of at least two fields in Oklahoma is attributed to information that was obtained by core drilling with the diamond drill.

Although a number of important developments have been made in drilling methods, particularly in those employed in rotary drilling, probably the most important has been the development and use of the rotary core barrel. By using the core barrel it has been possible not only to locate oil sands that would be passed in the ordinary method of rotary drilling, but to determine proper points for landing casing in order to prevent the entrance of water into the well. A more general use of mud and cement has doubtless resulted in the recovery of thousands of barrels of oil, which otherwise would have been lost by entrance of water into the wells and the migration of oil and gas into barren sands above.

Improvements in drilling equipment have made it possible to obtain oil from sands that only a few years ago were considered beyond the reach of the drill. Several of the most prolific fields in California are producing oil from depths in excess of 4,000 feet, and there are a number of deep wells in Oklahoma, Colorado, and Texas. A number of wells in California are producing from depths of 5,000 to 6,000 feet, and the deepest producing oil well in the world, which reached a total depth of 7,591 feet and is producing from a sand at 7,300 feet, is in the Athens field in California.

In addition to improvements in locating structures and in drilling the wells, there has been a constant effort on the part of the oil producer to obtain more oil from the sands and to save the oil after it has reached the surface. Improvements have been made in pumping equipment so that it is now possible to lift oil from the deep wells. Additional amounts of oil are now being recovered from oil-water emulsions, and in some sections of the country operating methods are being changed in order to make better use of the gas that is produced with the oil. Evaporation losses on the lease are being appreciably reduced by the installation of gas-tight tanks, and a large percentage of the gas that is produced with the oil is being run through absorption or compression plants in order to recover the gasoline that it contains.

Further details in regard to the efforts of the oil industry to continue to provide cheap motor fuel for the millions of American motorists are given in Information Circular 6003, "The Gasoline Situation," copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

POSSIBILITY OF FINDING OIL IN UTAH AND COLORADO

THE exploratory campaign for oil carried on in 1925 in the Rocky Mountains resulted in an outstanding discovery early in December, when a well on the Cane Creek dome, near Moab, Utah, began producing oil. This discovery suggest that in parts of southeastern Utah and southwestern Colorado notable quantities of oil may be obtained from the Pennsylvanian formation that now yields oil at Cane Creek and possibly from younger rocks in which oil may have accumulated by upward migration. Because of these possibilities it seems worth while to summarize briefly the results of a reconnaissance study of this region that was made during the summer of 1925 by W. T. Lee and W. W. Boyer, of the Geological Survey, Department of the Interior, and also the results of an examination of the San Rafael Swell by James Gilluly, of the Survey.

From information gathered by these field studies and from data already made available by previous geologic investigations, it seems probable that conditions similar to those recently found near Moab exist at other points in Utah south of the Denver & Rio Grande Western Railroad and east of Green River (or east of the one hundred and tenth meridian), and also in the adjacent part of Colorado south of the Uncompahgre Plateau.

The presence of oil in Pennsylvanian beds below the salt and gypsum zone has been demonstrated by the Cane Creek well and has been suggested by the small quantities of oil and gas that were found in the Big Six wells, near Moab, and in the Crescent-Eagle well, on the northwest end of the Salt Valley anticline. Because of faulting near these wells and the concealment of the bedrock the precise significance of these wells is not determinable. In general, however, anticlines in southeastern Utah and southwestern Colorado that are underlain by the beds now productive at Cane Creek may yield oil and gas, and it is barely possible that higher sands which overlie these Pennsylvanian beds may have been saturated with oil by upward migration.

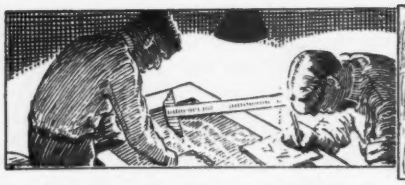
According to the work of the Geological Survey party in charge of James Gilluly, the beds that yield oil at Cane Creek may lie less than 3,000 feet below the surface near the crest of the San Rafael Swell, about 4 miles west of the Carter Oil Co.'s test well that was drilled on the Sinbad Plateau in T. 23 S., R. 12 E. Further exploration of the swell therefore appears to be warranted. Similarly the possibility of obtaining oil from the McElmo dome in Montezuma County, Colo., does not appear to be excluded by the failure of the test well drilled on it in 1921 by the Midwest Refining Co. This well, which was started in the lower part of a sandstone in the Dolores formation that was identified as the Wingate sandstone, apparently entered the Hermosa formation at 2,852 feet and below that depth penetrated numerous beds that yielded some oil and a considerable volume of gas, but it may not have reached the beds that are productive at Cane Creek.

IMPORTANCE OF CRACKING PROCESSES

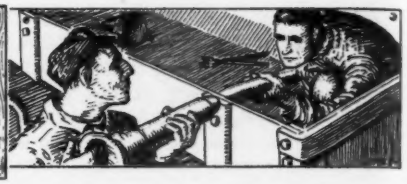
According to the best information available, about 25 per cent of the gasoline output of the refineries for 1925 was produced from heavier oils by cracking, states H. H. Hill, chief petroleum engineer, Bureau of Mines, in Information Circular 6003, recently issued. This represents a production of approximately 2,824,000,000 gallons of gasoline by the use of cracking processes as compared to 400,000,000 gallons in 1918 and 1,000,000,000 gallons for the five-year period preceding 1918. In other words, almost seven times as much gasoline was made by cracking in 1925 as in 1918, and almost three times as much as for the five-year period preceding 1918.

BIBLIOGRAPHY ON ZINC RETORTS

A "BIBLIOGRAPHY on Zinc Retorts and Condensers," prepared by B. M. O'Harra, metallurgist, Bureau of Mines, has been issued as a technical bulletin of the School of Mines and Metallurgy, University of Missouri, Rolla, Mo. The bibliography was compiled as a preliminary step in an investigation of refractory materials for the manufacture of zinc retorts and condensers, and of methods of manufacture, that is being conducted by the Mississippi Valley Station of the Bureau of Mines, in cooperation with the Missouri School of Mines and Metallurgy. It is published in the belief that it may be of interest to others who are carrying on similar investigations. The bibliography covers, it is thought fairly completely, the literature on the subject that has been published within the past 40 or 50 years.



WITH THE MANUFACTURERS



Wellman-Seaver-Morgan Sale

On January 1, 1926, the Motor Division of the Wellman-Seaver-Morgan Co., of Cleveland, Ohio, operated at Akron, Ohio, was purchased in its entirety by The Sanderson-Cyclone Drill Co. of Orrville, Ohio.

In the agreement covering this purchase all drawings and patterns, special machinery, tools and jigs, inventory and good will of W-S-M engines were transferred to the purchasers and the property has been moved to the new factory at Orrville, Ohio, where the engines are now being built and serviced.

Arrangements have been made whereby practically all former heads of the engineering and manufacturing departments of the Motor Division of the Wellman-Seaver-Morgan Co. are kept in the same capacities. Mr. John Riise, formerly chief engineer, who has been largely responsible for the design and development of W-S-M engines, now holds the same position. Services of the shop superintendent and the foremen of the machinery department, erecting department, and testing department have also been retained.

Pump-Motor Sequence Control

An interesting system of pump-motor control was recently devised by the General Electric Co. for controlling an installation of three squirrel cage-pump motors used to maintain the water level in a reservoir. It was desired that standard automatic starting compensators be used, with an auxiliary control which would give six combinations of the pump motors at six different levels of the water in the reservoir. It was further desired that but one of the pumps operate during certain periods of time, the other two automatically shutting down to start again only at the end of the shut-down period.

In view of the fact that ice would foul the mechanism of a float switch during the winter months, it was decided to use a Ruggles-Klingemann regulator panel having six control points, each point to represent a definite level of the water in the reservoir.

There were mounted on the panel the regulator, a dial switch, a control circuit switch, a time switch, and seven double-pole control relaying contactors. Rather than make up a new dial switch with six points, a field control switch with 21 buttons was utilized, the six points being obtained by wiring the 21 buttons into seven groups of three buttons each.

In operation the water dropping in the reservoir causes the regulator to operate, moving the dial switch to the first control point, actuating contactor No. 1 and starting pump motor No. 1 by means of the first automatic compensator. As the water level continues to drop, additional contactors up to the sixth are actuated. The first pump motor is rated 60 horsepower; the second, 100 horsepower; and the third, 150 horsepower. As each pump goes into operation on the first three points of the dial switch, the preceding one drops out. Pump No. 3 continues to operate on the fourth, fifth, and sixth points, and additional pumps are picked up on each point. On the fourth point Pump No. 1 is added; on the fifth point, Pump No. 1 drops out and No. 2 is picked up; and, on the sixth point, all three go into operation.

In order to provide operation of but one of the pumps during certain periods of time, a time switch and one of the control relaying contactors were used. The normally closed tips of the time switch were wired in the coil circuit of the contactor and the control circuits of the two automatic starting compensator panels were wired through the contactor. During normal operation the contactor is closed and all the pump motors start on their respective points. During the period of shutdown, however, the tips of the time switch open and the contactor drops out. As a result, but one pump motor operates, regardless of the position of the dial switch.

Complete Reorganization of Westinghouse Sales Department

A complete reorganization of the sales department, involving the reallocating of the managing personnel and the creating of several new activities has been announced by E. D. Kilburn, vice president and general sales manager of the Westinghouse Electric and Manufacturing Co., effective April 1.

The change, which involves all departmental sales managers of the company, consists of the following appointments: Assistant to vice president, E. H. Sniffin, formerly manager, power department; director of sales, T. J. Pace, formerly manager, supply department; central station manager, G. H. Froebel, formerly manager, marine department; industrial sales manager, J. M. Curtin, formerly manager, industrial department; transportation sales manager, M. B. Lambert, formerly manager, railway department; assistant director of sales, A. C. Streamer, formerly assistant to manager, supply department; generating apparatus manager, H. W. Smith, formerly general engineer; traction apparatus manager, A. J. Manson, formerly manager, heavy traction division, railway department; motor apparatus manager, O. F. Stroman, formerly assistant to manager, industrial department; switch-gear apparatus manager, R. A. Neal, formerly head of switch section, supply department; and distribution apparatus manager, G. A. Sawin, formerly assistant to manager, supply department.

Nelson Brandt to Manage Florida Office of Link-Belt Co.

Link-Belt Co., of Chicago, Indianapolis and Philadelphia, have recently announced that Mr. Nelson Brandt has rejoined their sales management force, and that he will manage a new branch office which is to be opened up in Florida.

This should be of interest to the many friends and former customers of Mr. Brandt, who is well known throughout the South, but particularly along the Atlantic seaboard, as an expert in engineering equipment.

He will not only solicit sales for both engineering and merchandise material throughout the state of Florida—with office location at, or in the vicinity of, either Jacksonville or Orlando—but he will also establish and maintain contact relations with the Link-Belt Co.'s agents, Cameron and Barkley. It is also reported that he will work hand in hand with Mr. L. J. DeHoney, the Chicago sales representative at Miami.

By use of transformers equipped with load ratio control a Belgian copper refinery will control the current used in its electrolytic processes by varying the voltage applied to a rotary converter, and without interrupting the circuit. By this method the Oolen Refinery of the Societe Generale Metallurgique de Hoboken will be able to exercise remote control of its processes by means of two push buttons on the control panel.

The installation will consist of two 915/1840-kilowatt, 750-r. p. m. synchronous converters and two oil-cooled trans-

formers rated 2055 kv-a., together with necessary switchgear. This equipment will be installed in a new refinery in Hoboken, Belgium, where copper from the Belgian Congo will be brought and refined. All the electrical equipment will be of General Electric manufacture, and that company is now also building three 4,000-kilowatt motor generators for a large leaching plant in the Belgian Congo, a subsidiary of the Societe Generale Metallurgique de Hoboken.

The Belgian transformers will take their power from a 3-phase, 6,600-volt, 50-cycle circuit, and will deliver 5,270 amperes to the rotary converters at a pressure which can be varied from 66 to 130 volts in nine steps. Finer adjustments in the direct current voltage will be obtained by field control.

The motor drive of the load ratio control will accomplish one complete tap change in about 10 seconds. It will be possible to operate the tap-changing mechanism by hand, with the motor disconnected. On the switchboard there will be an indicating instrument to show the attendant on which tap the transformer is operating.

New Static Condenser for Individual Motor Application

The Westinghouse Electric and Manufacturing Co. has recently developed a new line of static condensers for individual motor application on motor circuits of 220, 440, and 550 volts for two and three-phase circuits. The new condenser consists of insulation inclosed in a sheet-metal container and a porcelain terminal housing arranged for conduit connections.

The correction at the motor by means of these static condensers is productive of a number of advantages. Low losses of less than one-half percent, regardless of kv-a rating; power factor, correction at or very near the source as desired; improvement of voltage regulation at the motor or on the feeders due to the reduction of line current and flexible localized form of correction are some of the outstanding advantages.

In addition, further correction may be bought with each motor, or the condensers may be changed from one motor to another. These condensers, which may be connected at the motor side and switched on and off with the motor without additional attention may be obtained in one-half, one, two and one-half and five kv-a units. All live parts are completely covered, assuring safety to operators.

Orders received by the General Electric Co. for the first three months of the present year totaled $86,433,658, Gerard Swope, president, has announced. This compares with $83,846,236 for the first three months of 1925, or an increase of 3 percent.

New Spreading Device For Vibrating Screen Has Unique Application

A new arangement of a receiving hopper has just been announced by Link-Belt Company, of Nicetown, Philadelphia, as standard equipment for the vibrating screens manufactured by that company.

This hopper has been found, it is asserted, to be an excellent means of distributing materials quickly over the entire width of the screen cloth area, and a distinct help to better screening of applicable materials.

The new automatic feeding device, combined with the vibration of the hopper along with the screen, gives a rapid and uniform spread of the material, which takes advantage of every square foot of screening area; and thus adds about two feet to the effective screening length, without increasing the length of the machine.

It would seem, moreover, that the use of this spreading device should be greatly instrumental in eliminating rapid wear of the screen cloth at the receiving surface, permitting, in addition, the stratification of the particles at a higher rate of speed.

A swinging feed plate, with counterweighted adjustment (as shown in accompanying diagram) automatically regulates the feed.

This feed plate also spreads the material uniformly across the width of the screen cloth, enabling a non-uniform load, discharged fairly close to the center of the receiving hopper, to be spread evenly over the screen cloth at the proper rate of speed.

The Link-Belt Company aver that their unique attachment, used in conjunction with their vibrating screen, makes for a very high degree of screening efficiency.

New Foote Bros. Gear and Machine Catalogue

The new General Catalog of the Foote Bros. Gear & Machine Co., of Chicago, which has been in the course of preparation for about 18 months, has now been completed and is in the hands of the printer. It is expected that it will be available for distribution about the middle of May.

This catalog, in addition to being a complete price list of the company's spur and worm gear speed reducers, flexible couplings, sprockets and industrial gears of all kinds, contains a wealth of engineering information on gearing transmission and mechanical engineering subjects that makes it very valuable as a reference book.

It is suggested that executives and engineers interested in gearing and speed reduction subjects write for a copy of the catalog to be reserved, as the first edition will be limited in number.

New Publication on Application of Oil Circuit-Breakers

Special Publication 1643-A describing the application of oil circuit-breakers has just been released by the Westinghouse Electric and Manufacturing Co. It describes fully the general application of oil circuit-breakers, the determination of short-circuit current, and the precautions necessary, and devotes a number of pages to tables and charts. Several interesting halftone illustrations are also included.

This publication may be obtained from any of the district offices of the Westinghouse Co. or from the Department of Publicity at East Pittsburgh, Pa.

Mining Converters With Load Control

The first use in mining service of load control with rotary converters will be made by the Benedict Coal Corporation at St. Charles, Va. In the substation of this property, soon to be placed in operation, there will be two 200-kilowatt, 275-volt rotary converters with full automatic control, each machine being provided with protective devices to permit the obtaining of maximum power output without damage to the apparatus.

Normally a single machine will run to handle the load of three feeders. If, however, the load should exceed the capacity of this machine, the automatic equipment is arranged to start the second unit after a definite time delay has expired. This time delay prevents starting the second machine unnecessarily by momentary overloads. When the power is no longer needed, the second unit will automatically shut down.

Should the load increase to exceed the safe carrying capacity of both machines, one of the outgoing feeders will be automatically tripped, thus reducing the load to a safe value and, at the same time, not interrupting service on the other two feeders. Should an overload occur when one machine is running alone, two feeders will be tripped off and service will not be interrupted on the third feeder.

Should the running unit be shut down because of a hot bearing, winding failure, or other cause, the second unit will automatically start and restore service. Either machine may be made "leading," and both units may be run continuously if necessary. The entire station may be shut down by opening a small control switch located at some distance from the station.

New G. E. Drum Controllers

The General Electric Co. announces a new, completely standardized line of drum controllers embodying new features of construction and comprising units for general purpose, crane hoist, or machine tool applications, for either direct or alternating current. In each group several

sizes have been provided to cover a wide range in motor ratings, the smaller sizes being suitable for wall mounting and those for larger motors, for floor mounting.

A number of distinctive advantages are claimed for the new line. One of the particular features is in the mechanical construction, a skeleton type of frame being used. This consists of a cast cap plate and base to which are hot riveted rectangular steel bars, thus making it unnecessary for the back of the switch to function as a framework for holding the top and bottom of the switch together. As a result, the switch is accessible from both back and front for the purpose of making adjustments, renewals, etc.

A desirable feature, particularly valuable in crane service, is the interchangeability of operating handle mechanism. A vertical operating lever or a spring return mechanism may easily be substituted for the horizontal lever with which the switch is equipped by using another dial plate.

New style self-aligning contact fingers are used. By standardizing the renewable copper tips for all switches of the same capacity, renewal stocks will be reduced to a minimum. Where cross-arcing is likely to occur, adequate preventive barriers and blowouts are provided.

Auxiliary contact fingers are provided for control circuits to the line protective switch. The arrangement of these circuits is designed to suit the service requirements of installation.

Westinghouse Annual War Memorial Scholarships

The educational department of the Westinghouse Electric and Manufacturing Co. has just announced the plans for awarding the 1926 war memorial scholarships. These awards are made annually, the successful candidate receiving $500 during each year of his collegiate training, or a maximum of $2,000.

Applicants eligible to compete for these scholarships include sons of employes who have been with the company five years or more, and employes who have been continuously in the service for at least two years, and who shall not, on September 1, have exceeded the age of 23.

At a recent meeting of the directors of the Foote Bros. Gear & Machine Co., of Chicago, W. C. Davis was reelected to the office of president, and also elected treasurer of the company.

E. H. Vogt, former auditor and credit manager, was elected secretary and assistant treasurer.

The Rollway Bearing Co., Inc., Syracuse, N. Y., manufacturers of heavy duty roller bearings for radial and thrust loads, announces the following changes in personnel of their sales force:

C. A. Call, formerly assistant sales manager, Gurney Ball Bearing Co., has been appointed sales manager.

E. J. Lybert, formerly representing the Rollway Co. in the Philadelphia district, now takes charge of the Detroit district.

J. D. Firmin, for many years associated with the engineering department of Niles-Bement-Pond, is now engineering representative in the Philadelphia district.

W. E. Smith has been transferred from the home office to the Youngstown district, where he will assist Samuel Farrell, district representative.

S. J. Kaiser continues to represent the company in the Chicago territory.

Maurice M. Hart, who has been with the Morse Chain Co. for several years in the production department, and the last two years in the sales department, has been appointed manager of the Buffalo District. An office has been opened in the Ellicott Square Building, Buffalo, N. Y.

C. G. Buchanan Company, 90 West Street, New York City, manufacturers of crushing rolls, has issued a new bulletin No. 130, explaining their Type C, crushing roll.

DuPont Powder Co.'s Explosives Service Bulletin, No. 10, for March, is devoted to a discussion of electric blasting, and ways and means of avoiding trouble in this method of firing explosives. Charles S. Hurter is the author.

POTASH AND THE SOUTH

(*Continued from page* 346)

Drilling by churn or rotary drill to a depth of 1,700 feet and then taking a 3-inch core for 200 feet below that might, with good luck, be done for $45,000. With a considerable portion of the grief and calamities incident to such work the well might cost $100,000 or more. A fair estimate for a series of such wells would seem to be about $75,000 each. If it were necessary to build roads and bridges, to haul water, and to provide lubricating liquids other than water to prevent the solution of soluble salts during drilling, the average cost would be greater.

As exploration is carried on in the salt beds, research, which is merely scientific laboratory exploration, should be carried on simultaneously with the purpose of making available the huge quantities of potash contained in glauconite and other compounds insoluble in water. Do not let me give the idea that this work is simple nor that results are sure. However, one of the two forms of exploration may give us the gun to keep under our national pillow, and no part of the Union is quite so personally interested in seeing this work done as is the South.

If these researches are not pushed to some successful conclusion, we may at anytime find the prices of 1920 again in effect and before we can help ourselves we may be compelled to pay an extra $100,000,000 for our potash. It seems well worth making the trials.

These contingencies have been sensed by two statesmen from Texas, and Senator Sheppard has introduced S. 1821, which would appropriate $550,000 per year for five years for exploration and research. Representative Hudspeth has introduced in the House H. R. 3863, appropriating $1,000,000 per year for five years for the same purpose.

Both are excellent bills. Mr. Hudspeth's is nearly doubly good because it appropriates almost twice as much and will allow about twice as much to be done.

Should success be achieved in the proposed explorations the South would be the first benefited, but the whole country would soon feel the effect.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of THE MINING CONGRESS JOURNAL, published monthly at Washington, D. C., for April 1, 1926.

City of Washington,
District of Columbia, ss:

Before me, a notary public in and for the state and county aforesaid, personally appeared R. S. Mowatt, who, having been duly sworn according to law, deposes and says that she is the assistant business manager of the MINING CONGRESS JOURNAL, and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse side of this form, to wit:

1. That the names and addresses of the publisher, editor, and business managers are:

Name of publisher, The American Mining Congress; post-office address, Washington, D. C.

Editor, E. R. Coombes; business manager, E. H. Strong.

2. That the owners are (give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 percent or more of the total amount of stock): The American Mining Congress—a corporation, not for profit. No stockholders. Hugh Shirkie, president, Terre Haute, Ind. E. L. Doheny, first vice-president, Petroleum-Securities Bldg., Los Angeles, Calif. Wm. H. Lindsey, second vice-president, Nashville, Tenn. Robt. E. Tally, third vice-president, Clarkdale, Ariz. J. F. Callbreath, secretary, 841 Munsey Bldg., Washington, D. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are (if there are none, so state): None.

R. S. MOWATT,
Assistant Business Manager.

Sworn to and subscribed before me this 5th day of April, 1926.

[SEAL.] THOMAS C. WILLIS.

(My commission expires January 10, 1927.)

The Fordson Coal Company, Stone, Ky., have in service four Leschen two-bucket power-driven tramways to dispose of mine waste in nearby ravines. The buckets dump automatically on the line.

The Monticello Smokeless Coal Co., Monte Carlo, W. Va., installed a Leschen single-span two-bucket gravity tramway which enabled them to load cars at the rate of over 200 tons per hour.

The Bartley Mine in W. Va. is equipped with Hercules (Red-Strand) Wire Rope. "Hercules" is also extensively used at other Island Creek (the 1925 model mine) properties on inclines, car retarders, tipping booms and cranes.

The LESCHEN Ways To Lower Mine Costs

LESCHEN AERIAL TRAMWAYS are demonstrating daily in many large and small mines that they can reduce coal handling costs. They are also cutting costs in the disposal of mine waste. These wire rope tramways are noted for their low upkeep cost. We have designed and manufactured Aerial Wire Rope Tramways for over 25 years and you can depend upon the Leschen Systems to give you safe and efficient service.

"HERCULES" (Red-Strand) WIRE ROPE has a long and well-known record for economical service in the coal industry. Its strength, elasticity, toughness and durability have made it an important factor in reducing mine costs. It is especially recommended for use on hoists, inclines, mining machines and steam shovels.

Products of 69 Years of Manufacturing Experience

A. LESCHEN & SONS ROPE CO.
5909 Kennerly Avenue
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New York **Chicago** **Denver** **San Francisco**

"HERCULES" (RED STRAND) WIRE ROPE

Reg. U. S. Pat. Off.

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42nd St., N. Y. C.

ACETYLENE GAS
Prest-O-Lite Co., 30 East 42nd St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AUTOMATIC CAR CAGES
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

AUTOMATIC FEEDERS, GRAVITY
G. M. Johnson Mfg. Co., Jeannette, Pa.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.
G. M. Johnson Mfg. Co., Jeannette, Pa.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42nd St., New York City.

BATTERY SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

BEARINGS (Roller)
Hyatt Roller Bearing Co., Harrison, N. J.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

BOND TERMINALS
Amer. Mine Door Co., Canton, Ohio.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BUCKETS (Elevator)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLES
American Steel & Wire Co., Chicago and New York.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.

CABLEWAYS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGERS, AUTOMATIC
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
G. M. Johnson Mfg. Co., Jeannette, Pa.
Mining Safety Device Co., Bowerston, Ohio.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
G. M. Johnson Mfg. Co., Jeannette, Pa.

CAGES (Self-dumping)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAGE STOPS AND LOCKS
Mining Safety Device Co., Bowerston, Ohio.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CAR DUMPERS (Rotary)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR HAULS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CAR STOPS (Automatic)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR WHEEL BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CASTINGS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAIN RAIL CAR HAULS
G. M. Johnson Mfg. Co., Jeannette, Pa.

CHAINS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, DRIVE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHILI MILL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CLAMPS (Trolley)
Ohio Brass Co., Mansfield, Ohio.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.
Bertha-Consumers Company, Chamber of Commerce Bldg., Pittsburgh, Pa.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL LOADERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL MINING PLANTS
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COKE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago and New York

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

CONTROLLERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

CONVERTORS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

CONVEYOR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CONVEYORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, COAL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, PAN OR APRON
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CORE DRILLING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

COUPLINGS, FLEXIBLE
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.

CRUSHER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CRUSHERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CRUSHERS, COAL
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CRUSHERS, SINGLE & DOUBLE ROLL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

DESIGNERS OF PLANTS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DIAMOND CORE DRILL CONTRACTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

DIAMOND DRILLING CARBON
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
R. S. Patrick, Sellwood Building, Duluth, Minn.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOUBLE CRIMPED WIRE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLING, DIAMONDS FOR
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, CORE
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DYNAMITE
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC WIRES AND CABLES
American Steel & Wire Co., Chicago and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.

ELEVATORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATORS, BUCKET
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATOR MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINEERS
H. R. Ameling Prospecting Co., Rolla, Mo.

EXPLOSIVES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

FAN DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Mining Safety Device Co., Bowerston, Ohio.

FEEDERS (Hand operated)
Mining Safety Device Co., Bowerston, Ohio.

FEEDERS, ORE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

FEEDERS (Semi-automatic)
Mining Safety Device Co., Bowerston, Ohio.

FILTER WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS AND SWITCHES
Amer. Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42nd St., New York City.

GAUGES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GEARS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GEARS, REDUCTION
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GEARS, HERRINGBONE
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GEARS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GEARS, WORM
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

GEARS, WORM WHEELS
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros., Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

HEADLIGHTS, ARC AND INCANDESCENT
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

HERRINGBONE GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

HOIST DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

HOISTS
American Steel & Wire Co., Chicago and New York.
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, AIR
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Diamond Machine Co., Monongahela, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

HOISTS (Room and Gathering)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

HOISTING ROPES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

INSULATORS, FEEDER WIRE
Ohio Brass Co., Mansfield, Ohio.

INSULATORS, SECTION
Amer. Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Porcelain)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Third Rail)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
Roebling Sons, John A., Trenton, N. J.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

LOADERS (Mine Car)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, PORTABLE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

LOCOMOTIVES, STORAGE BATTERY
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MACHINERY, TRANSMISSION (Power)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MILLS, STAMP
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINE CAR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MINING MACHINES
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINE SIGNALS
American Mine Door Co., Canton, Ohio.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

NITROGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.
Phelps-Dodge Corporation, New York City.

OXYGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PATENT ATTORNEY
John Boyle, Jr., Ouray Bldg., Washington, D. C.

PERMISSIBLES, Explosives
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INDEX TO ADVERTISERS

	Page
Allis-Chalmers Manufacturing Co.	30
Ahlberg Bearing Co.	60
Ameling Prospecting Co., H. R.	69
American Appraisal Co.	67
American Brass Co.	15
American Car & Foundry Co.	40
American Mine Door Co.	4
American Rheolaveur Corp.	39
American Steel & Wire Co.	14
Atlas Powder Co.	53
Automatic Reclosing Circuit Breaker Co.	24-25
Bethlehem Steel Co.	38
Boyle, John, Jr.	71
Byers Co., A. M.	7
Cameron Steam Pump Works, A. S. (Ingersoll-Rand Co.)	6
Car Dumper & Equipment Co.	8
Centerville Foundry & Manufacturing Co.	43
Central Frog & Switch Co., The	51
Central Steel Co.	18
Cincinnati Electrical Tool Co.	60
Concordia Electric Co.	42
Connellsville Mfg. & Mine Supply Co.	10
Cutler-Hammer Mfg. Co.	24-25
Deming Co., The	22
Diamond Machine Co.	12
Dravo-Doyle Co.	58
DuPont de Nemours Co., E. I.	26-27
Eagle Iron Works	32
Edison Storage Battery Co.	37
Electric Railway Equipment Co.	35
Ellis Mill Co.	69
Enterprise Wheel & Car Corp.	49
Fawcus Machine Co.	69
Flory Mfg. Co., S.	14
General Coal Co.	73
General Electric Co.	56
Goodman Mfg. Co.	34
Grasselli Powder Co., The	13
Hercules Powder Co.	3

	Page
Hoffman Bros. Drilling Co.	71
Hulburt Oil & Grease Co.	52
Hyatt Roller Bearing Co.	(Inside Front Cover)
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works)	6
Irvington Smelting & Refining Works	69
Jeffrey Mfg. Co.	46-47
Johnson Mfg. Co., G. M.	71
Joy Mfg. Co.	59
Keystone Churn Drill Co.	69
Keystone Lubricating Co.	29
Koehler Mfg. Co.	41
Lehigh Coal & Navigation Co.	71
Leschen & Sons Rope Co., A.	63
Link Belt Co.	78
Mine Safety Appliances Co.	33-61
Mining Safety Device Co.	45
Morse Chain Co.	(Back Cover)
Mott Core Drilling Co.	71
Myers-Whaley Co.	23
National Carbon Co.	57
Nuttall Co., R. D.	48
Ohio Brass Co.	21
Patrick, R. S.	69
Phelps Dodge Corp.	71
Pittsburgh Knife & Forge Co.	61
Prest-O-Lite Co.	65
Raymond Bros. Impact Pulverizer Co.	11
Ridgway Dynamo & Engine Co.	24-25
Roberts & Schaefer Co.	(Front Cover)
Robinson Ventilating Co.	44
Roebling's Sons Co., John A.	50
Stonehouse Signs, Inc.	71
Sullivan Machinery Co.	31
Thorne Neale & Co.	73
Timken Roller Bearing Co.	54-55
Vulcan Iron Works	9
Watt Wheel & Car Co.	36
West Virginia Rail Co.	28
Willmarth, O. Barlow	71

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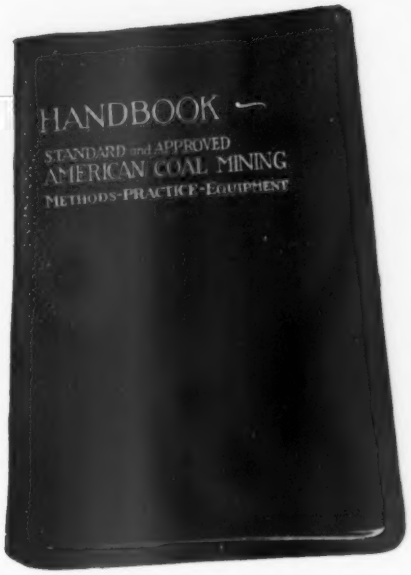

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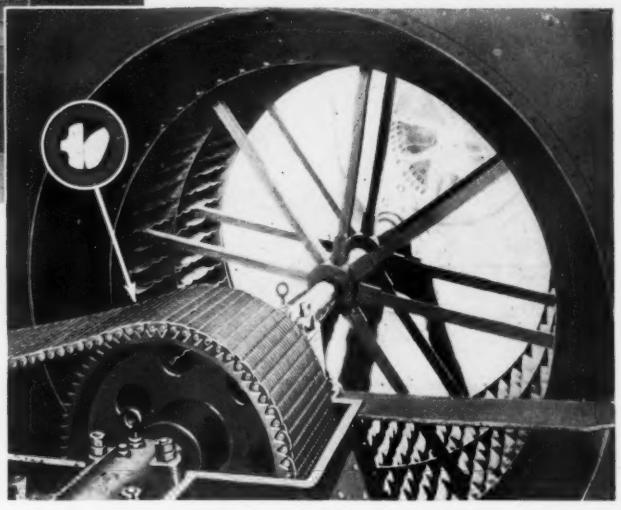

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